

SPECIES OF INSECTS HARMFUL TO LEAVES, BUDS, AND FLOWERS IN THE APPLE ORCHARDS OF SOUTHERN ROMANIA

Mădălina Rădulea¹, Maria Iamandei^{1*}, Ionuț Cristian Popa¹, Raluca Gabriela Georgescu¹, Andrei Chiriloaie-Palade¹, Cecilia Bolbose²

¹Research - Development Institute for Plant Protection Bucharest, România

²Fruit Growing Research Station Voinești, Dâmbovița

*Correspondence address:

Research-Development Institute for Plant Protection
Bd. Ion Ionescu de la Brad 8, CP 013813, Bucharest, Romania
Tel.: 004-021-2693231 (32, 34)
Fax. 004-021-2693239
E-mail: maria_iamandei@yahoo.com

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Abstract: The aim of the study was to update knowledge of the complex of harmful species that damage apple tree buds, flowers and leaves in orchards in the southern part of Romania. The pest fauna identified by visual observation and collection of infested plant material in the 2021 study, performed in 3 orchards, was represented by a total of 4 species of beetles: *Phyllobius pomaceus*, *P. oblongus*, *Anthonomus pomorum* (Coleoptera: Curculionidae) and *Tropinota (Epicometis) hirta* (Coleoptera: Scarabaeidae) and 12 species of moths: *Phyllonorycter blancardella* (Lepidoptera: Gracillariidae), *Stigmella malella* (Lepidoptera: Nepticulidae), *Hyphantria cunea* (Lepidoptera: Erebidae), *Leucoptera malifoliella*, *Lyonetia clerkella* (Lepidoptera: Lyonetiidae), *Adoxophyes orana*, *Archips podanus*, *A. rosanus*, *Clepsis consimilana*, *Pandemis heparana*, *P. cerasana* and *Hedia nubiferana* (Lepidoptera: Tortricidae). The report reveals the variations among orchards, in terms of species composition, relative abundance of common species and their importance for the region.

Key words: apple pest, defoliators, arthropod pest diversity, apple orchards

INTRODUCTION

According to Food and Agriculture Organization (FAO) data, in 2021, the apple was cultivated in 95 countries on an area of over 4,800,000 ha and the world production of apples was about 93,144,000 tons, which represents about 10.2% of the total fruits (FAO, FAOSTAT, 2021). The largest apple-producing countries are: China, with over 46 million tons, Turkey with 4.5 million tons, the USA, with 4.4 million tons, Poland, with 4 million tons and India with 2.3 million tons. Romania with 0.6 million tons was placed on 24th place worldwide and 9th in Europe (FAO, FAOSTAT, 2021). Throughout history, there were 10,000 to 30,000 known apple varieties. Currently, less than forty are used and traded commercially all over the world (Atofani et al., 2011, agribenchmark.org).

The existence of a large number of varieties with staggered ripening in different periods and the possibility to keep fresh the fruits for a long time, ensures the consumption of fresh fruit almost throughout the year, promoting apple culture as the most important from Romania fruit market, with intensive and super-intensive orchards found at the foot of the hills and in the plateau areas (Rakosy et al., 2003). Apple trees adapt to different soils and climatic conditions and could achieve high production, a reason why the crop is cultivated in almost all regions of Romania (Gitea, 2014).

Apple is attacked by a variety of pests that reduce the fruit's quality and quantity, and therefore it requires the implementation of specific control measures. Besides *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) which is one of the key pests and requires the application of intensive control measures throughout the country, there are other lepidopteran

species whose caterpillars are defoliators or cause damage to the green organs of the apple trees (leaves, buds, shoot tip or flowers. More than 50 species of Lepidoptera belonging to the families Argyresthiidae, Choreutidae, Gelechiidae, Gracillariidae, Oecophoridae, Plutellidae, Tortricidae, Yponomeutidae, Dilobidae, Geometridae, Lymantriidae, Lasiocampidae, Lycaenidae, Lyonetiidae, Nepticulidae Noctuidae and Papilionidae have been confirmed to occur in Romanian apple orchards (Diaconu, 1997, 2007; Drosu, 1996; Rakosy et al., 2003). Moreover, specialized or polyphagous species can be discovered among pests that attack apple trees: mites (Van Leeuwen et al., 2010), aphids (Footitt et al., 2006; Lowery et al., 2006) and beetles (Markó et al., 1995).

Currently, only a few significant and widespread pests, such as *C. pomonella*, mites, aphids and San Jose scales, are considered in apple orchard management programs. The scarcity of recent researches and the context of current climate changes, require a careful study of the situation, regarding the diversity and abundance of the fauna of harmful species, as a basis for the development of updated pest management programs.

The purpose of this study was to update the knowledge on complexes of insect pests causing damage to buds, flowers, leaves of apple orchards under different conditions in southern Romanian.

MATERIAL AND METHODS

The study was performed in 2021, from the beginning of April to the end of October, in three experimental apple orchards located in Voinești (Dâmbovița County), Bucharest and Moara Domneasă (Ilfov County) (Figure 1). The main characteristics of the orchards are presented in table 1.

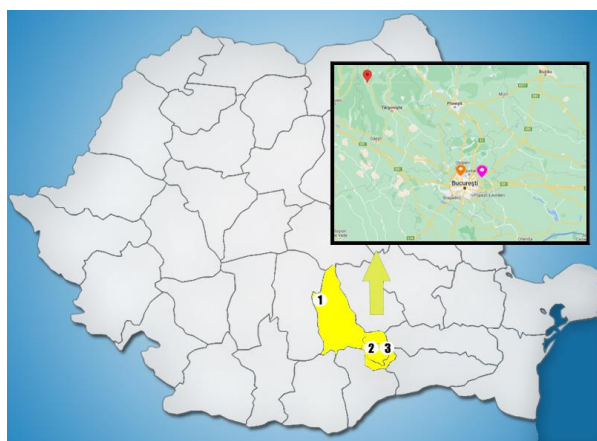


Figure 1. Selected orchards location, on the Romanian map:
 1- Voinești, 2- Bucharest, 3- Moara Domneasă

Table 1. The main characteristics of the study orchards

Orchard ID	Locality	Apple variety	Plantation age (Year)	GPS coordinates	Meters above sea level (m)
O1	Voinești (Dâmbovița County)	Jonathan	21	N 45.08628 E 025.23645	386
O2	Bucharest	Golden Delicious	19	N 44.50226 E 026.076838	91
O3	Moara Domneasă (Ilfov County)	Ionagold	16	N 44.49987 E 026.25724	75

In each orchard, on a section of 200-400 square meters that was intentionally untreated with insecticides, 10 trees were randomly selected, marked and weekly assessed from April to September for presence of pest species. Only necessary fungicide treatments were applied against pathogens during the study period on selected apple areas. The presences of pests in adult stage were monitored visually on 10 shoots per tree, randomly selected from various positions on the tree crown, by examining buds, tips/leaves, giving particularly attention to leaves webbed, to floral buds or fruits. The numbers of adults from each pest species were recorded. The number of shoots, buds and/or leaves with symptoms of pest attack was noted. The entire detected plant material that contained attack signs and larvae has been collected and transferred to Research-Development Institute for Plant Protection, Bucharest, entomology laboratory, awaiting the development of the adult stage for proper identification. After identification, the numerical and relative abundance of every taxon has been calculated for each orchard and per total study samples.

Relative abundance (R%) was calculated according to the formula: $R\% = n/N \times 100$, where n = the total number of individuals of a species and N = the total sum of the population of all identified species.

RESULTS AND DISCUSSIONS

A total of 679 specimens of bud, flower and leaves pest species occurred in the investigated apple orchards from Southern Romania in 2021 were sampled, the list comprising 16 species belonging to Coleoptera and Lepidoptera orders (Table 2).

The highest abundance of pests has been registered at Voinești (478 individuals in total) followed by Moara Domnească (137 individuals) and the lowest abundance was observed at Bucharest orchard (only 64 specimens).

The greatest richness of species was registered at Moara Domnească (O3) and Voinești (O1) orchards (with 11 species each), while 7 species were identified in Bucharest orchard (O2). The only beetle species present in all locations was *Phyllobius oblongus* (Linnaeus) which was also the most abundant coleopteran, representing 3.25% of the total fauna. Dangerous pests *Anthonomus pomorum* (Linnaeus) and *Tropinota (Epicometis) hirta* (Poda) were exclusively found at Moara Domnească orchard and had a very low incidence in 2021 spring. The florivorous species *A. pomorum* (apple blossom weevil) and *T. hirta* (apple blossom beetle) are the most economically relevant insect pest of apple orchards in early spring. In Romania, researches concerning biology, ecology and control of apple pests have been initiated by Manolache et al. (1957), Isac (1965), Șuta (1976), Săvescu & Rafailă (1978), Baicu & Săvescu (1986). These were continued by Iorga (1990), Lefter & Minoiu (1990), Ungureanu (2006), Drosu (1996) and more recently in small-scales studies by Coșoveanu & Pălăgeșiu (2010), Tălmăciu et al. (2005), Loghinoaei et al. (2011), Jakab-Ilyefalvi (2015), and Rosu-Mares et al. (2021).

Table 2. Pest species and abundance in apple tree buds, flowers and foliage across the three analysed orchards during the 2021 monitoring period

Sp. No.	Pest Order and Family	Species	No. of specimens (n) and relative abundance (R%)/orchard						Total No.	R%
			01		02		03			
			n	R%	n	R%	n	R%		
1	Coleoptera: Curculionidae	<i>Phyllobius pomaceus</i> , (Gyllenhal, 1834)	0	0.00	3	4.69	16	11.68	19	2.80
2		<i>P. oblongus</i> (Linnaeus, 1758)	2	0.42	6	9.38	14	10.22	22	3.24
3		<i>Anthonomus</i>	2	0.42	0	0.00	0	0.00	2	0.29

		<i>pomorum</i> (Linnaeus, 1758)								
4	Coleoptera: Scarabaeidae	<i>Tropinota (Epicometis) hirta</i> (Poda, 1761)	0	0.00	0	0.00	3	2.19	3	0.44
5	Lepidoptera: Gracillariidae	<i>Phyllonorycter blancardella</i> (Fabricius, 1761)	175	36.61	16	25.00	28	20.44	219	32.25
6	Lepidoptera: Nepticulidae	<i>Stigmella malella</i> (Stainton, 1854)	32	6.69	9	14.06	4	2.92	45	6.63
7	Lepidoptera Erebidae	<i>Hyphantria cunea</i> (Drury, 1773)	0	0.00	0	0.00	24	17.52	24	3.53
8	Lepidoptera: Lyonetiidae	<i>Leucoptera malifoliella</i> (Costa, 1836)	65	13.60	16	25.00	21	15.33	102	15.02
9		<i>Lyonetia clerkella</i> (Linnaeus, 1758)	12	2.51	0	0.00	0	0.00	12	1.77
10	Lepidoptera: Tortricidae	<i>Adoxophyes orana</i> (Fischer von Rösslerstamm, 1834)	152	31.80	12	18.75	18	13.14	182	26.80
11		<i>Archips podanus</i> (Scopoli, 1763)	15	3.14	0	0.00	2	1.46	17	2.50
12		<i>Archips rosanus</i> (Linnaeus, 1758)	5	1.05	0	0.00	0	0.00	5	0.74
13		<i>Clepsis consimilana</i> (Hübner, 1817)	12	2.51	0	0.00	0	0.00	12	1.77
14		<i>Pandemis heparana</i> (Denis & Schiffermüller, 1775)	6	1.26	0	0.00	0	0.00	6	0.88
15		<i>Pandemis cerasana</i> (Hübner, 1786)	0	0.00	2	3.13	4	2.92	6	0.88
16		<i>Hedia nubiferana</i> , (Haworth, 1811)	0	0.00	0	0.00	3	2.19	3	0.44
	Total number of specimens		478	100	64	100	137	100	679	100
	Total number of species		11		7		11		16	

T. hirta is a polyphagous pest which feeds on flowers of numerous plants species whose flowering coincides with the time of its flight and may damage up to 70% of the blossoms on apple trees or some plants of agricultural importance (Kutinkova & Andreev, 2004, Ražov et al., 2009, Trotuş et al., 2015). From 2009 to 2013, there were some reports on the damage caused by *T. hirta* in Timiș county, culminating in the destruction of 7 hectares of orchards (four species of apple, peach, apricot and cherry) in Jimbolia town area (<https://www.tion.ro>).

In total, 12 lepidopteran species belonging to 10 genera and 5 families were reared from larvae collected in 2021 (Table 2). The greatest number of species was registered at Voinești and Moara Domnească orchards (with 9 and respectively 8 species), while only 5 species were identified in Bucharest orchard. Four species were present in all locations and the most abundant were the moths: *Phyllonorycter blancardella* (Fabricius) (32.5%), *Adoxophyes orana* (Fischer von Rösslerstamm) (26.92%), *Leucoptera malifoliella* (Costa) (14.94%) and *Stigmella malella* (Stainton) (6.66%). At Voinești orchard, *P. blancardella* and *A. orana* were the predominant species while at the other two orchards were *P. blancardella* and *L. malifoliella*. Except for the four Lepidoptera species previously mentioned, differences between the orchards in species composition could be observed in the 2021 study. Two species were present in two (of the three analysed) orchards: *Archips podanus* (Scopoli) has been found at Voinești and Moara Domnească, *Pandemis cerasana* (Hübner) at Bucharest and Moara Domnească. Other 6 Lepidoptera species were present just in one location: *Hyphantria cunea* (Drury) and *Hedia nubiferana* (Haworth) at Moara Domnească and *Lyonetia clerkella*

(Linnaeus), *A. podanus*, *Clepsis consimilana* (Hübner), and *Pandemis heparana* (Denis & Schiffermüller) at Voinești orchard.

Data in this study confirm results from the 1980s and 1990s of Drosu (Drosu, PhD thesis, 1996) who studied the harmful mining moths in apple plantations in various region from Romania, finding that the top five economically dangerous species were: *P. blancardella*, *P. corylifoliella*, *L. malifoliella*, *L. clerkella* and *S. malella*, and the most abundant pest in the area of Bucharest and southern Romania was *P. blancardella*. In contrast, our study revealed a very low abundance of *L. clerkella* (1.77%). A study performed in the Moldova region reported *A. orana*, *A. podana* and *P. heparana* as the most important carnation leaf-rollers in apple orchards of SCDP Fălticeni in north-eastern Romania (Loghinoaei et al., 2011). A more recent study performed in 4 apple orchards from Bistrița-Năsăud County in north Romania revealed that *P. blancardella* abundance in pheromone traps was significantly higher than that recorded in the case of major pest of apple *Cydia pomonella*. The same study underlines that some defoliators such as *Spilonota ocellana* (Denis & Schiffermüller), *H. nubiferana* and *L. malifoliella* represent an important part of the pest insect fauna that need adequate control strategies in the central and northern area of the country (Roșu-Mareș et al., 2021).

CONCLUSIONS

In 2021, a total of 16 bud, flower, and leaves pest species belonging to Coleoptera (4 species) and Lepidoptera (12 species) were noted in the investigated apple orchards from Southern Romania.

The results in this study confirmed some previous data on the prevalence of *Phyllonorycter blancardella*, *Leucoptera malifoliella* and *Stigmella malella* for investigated area and revealed the high relative abundance of *Adoxophyes orana*. The four species were common for all analyzed orchards, *Lyonetia clerkella* was exclusively at Voinești orchard.

Anthonomus pomorum and *T. hirta* had a very low abundance but the situation should be carefully monitored because the pest control is challenging and should be applied during the flowering period and subsequently can have unwanted effects for important non-target species like bees and other pollinators.

In favourable years and conditions, any of the pest species found in the area can be a subject of an outbreak. All pest species must be kept under surveillance and further research is needed for a multiannual analysis of population abundance and dynamics of phyllophagous pests.

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