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Monitoring the Seasonal Flight Activity of Three Tortricid Pests in Bulgaria with a Single Sex Pheromone-baited Trap

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Abstract: Transparent sticky CSALOMON® RAG traps baited with (*E*)-9-dodecenyl acetate (*E*9-12Ac) and (*Z*)-9-dodecenyl (Z9-12Ac) were used to study the seasonal flight of the cherry bark tortrix, *Enarmonia formosana* and the pine resin-gall moth, *Retinia resinella* in the region of Sofia, Bulgaria during 2008 - 2010. Our results showed a continuous flight period for *E. formosana* - from the beginning of May to the first decade of October. Catches of *R. resinella* were recorded from the beginning of May to the second half of July. In addition to target species, we recorded 14 non-target tortricids during this study. The most abundant species among them was *Cnephasia pasiuana*, a known pest on poaceous crops in Bulgaria. We reported the attraction of males of this species to a mixture of *E*9-12Ac and *Z*9-12Ac in a ratio of 1: 1 (dosage 300 µg). Catches of *C. pasiuana* males were established from the second decade of June to the end of July – beginning of August. In 2010, when we compared sticky traps with dry covered funnel CSALOMON® traps baited with the same pheromone lures, the most catches of tortricids (98 %) were recorded in the sticky traps. Transparent sticky traps baited with a binary mixture of *E*9-12Ac and *Z*9-12Ac proved to be a useful tool for detection and monitoring of *E. formosana*, *C. pasiuana* and *R. resinella* in Bulgaria.

Key words: *Enarmonia formosana, Retinia resinella*, *Cnephasia pasiuana,* pheromone traps, monitoring, Bulgaria

Introduction

Currently, monitoring with pheromone traps is an important part of Integrated Pest Management programs of many harmful lepidopteran species because trapping information can be used to detect early pest infestation, define areas of pest infestations, obtain data about the biology and ecology of the target species and to help in decision making to reduce unnecessary insecticide treatment in integration with agronomic preventive measures and biorational control (Damos *et al*. 2015, McNair *et al.* 2000, Rodriguez-Saona & Stelinski 2009, Rosca *et al*. 1998, Witzgall *et al*. 2010).

Two tortricid pest species with hidden larval habits, i.e. the cherry bark tortrix, *Enarmonia formosana* (Scopoli, 1763) and the pine resin-gall moth, *Retinia resinella* (L., 1758), were the initial objects of our study. The cherry bark tortrix is distributed in North America, Europe, North Africa, Asia Minor and Siberia. This species is a pest of fruit trees including apples (*Malus* Mill.), apricot, almond, cherries, peach, plum (*Prunus* L.), pear (*Pyrus* L.), cydonia (*Cydonia* Mill.), mountain ash (*Sorbus* L.) (Rosaceae), hawthorn (*Crataegus* Tourn. *ex* L.), *Photinia* Lindl. and European beech (*Fagus sylvatica* L.) (Fagaceae) (Tanigoshi & Stary 2003, Palinkas 2001). Larvae feed under the bark: the first instar larvae feed exclusively in the outer part of the phloem, while later instars may colonise the entire space between the cork and cambium, causing the bark to loosen and crack (Jenner *et al*. 2004). In addition to the direct damages, *E. formosana* cause indirect damages of the host plants through the formation of habitats for secondary pests such as bark beetles, fungi and increased susceptibility of infested trees to unfavourable weather conditions (Dickler & Zimmermann 1972). This species is widely distributed in Bulgaria and it is considered as an important pest of pome fruit trees in this country (Grigorov 1972, Angelova *et al*. 2006).

The pine resin-gall moth can be found from Europe to eastern Russia, China (Heilongjiang, Inner Mongolia) and Japan (Zhang & Li 2005). Larvae of this species feed on young twigs of the scotch pine *Pinus sylvestris* L., 1753 but damages of *P. mugo* Turra, *P. nigra, P. sylvestris* var. *mongolia* Litvin., *P. ponderosa* Douglas ex C. Lawson and *P. sibiricus* (Loud.) Mayr also have been recorded (Barta 2009, Basset 1985, Buresh & Lazarov 1956, Herrero *et al*. 2012, Scherbakova 2011). Larvae cause small wounds that induce the secretion of resin, which is manipulated by the larva to construct a nodule-like resin capsule, commonly known as "resin gall". The larva lives in the shoots of pine where it causes a resin gall to develop. In Bulgaria, *R. resinella* is widespread in *P. sylvestris* plantations (Tsankov *et al*. 1996, Tsanova *et al*. 1979).

It is known that *E. formosana* and *R. resinella* use the same two-component mixture in their pheromone communication systems. McNair *et al*. (1999a) identified (*E*)-9-dodecenyl acetate (*E*9-12Ac) and (*Z*)-9-dodecenyl acetate (*Z*9-12Ac) as major components of the sex pheromone of the cherry bark tortrix in British Columbia, Canada. In this study, the authors proposed a 50:50 and 40:60 ratios for the optimal attraction of males. During screening of compounds with pheromone activity and their binary mixtures, Booij & Voerman (1984) found that *R. resinella* males were attracted to a two-component mixture of *E*9-12Ac + *Z*9-12Ac (1: 1 ratio). Commercial sex pheromone lures CSALOMON® composed of these two components attract the males of *E. formosana* and *R. resinella* (www.csalomontraps.com). The two unsaturated acetates are typical sex pheromone components in the sex pheromones in Tortricidae, and their two-component mixtures attract more than 20 tortricid species of subfamilies Olethreutinae and Tortricinae (El-Sayed 2016).

During our study, apart from the target species, also relatively high catches of *Cnephasia pasiuana* (Hübner, [1796-99]) male moths were registered in the traps and this was the reason to monitor its seasonal flight also. The species had been considered by some authors as a senior synonym of *C. pumicana* (Zeller, 1847) for a long time, but the status of the latter was revised recently (Langmaid & Agassiz 2010). The male genitalia of our specimens clearly demonstrated affinity to *C. pasiuana* sensu Langmaid & Agassiz (op. cit.). *Cnephasia pasiuana* is distributed in the Palaearctic region and has a wide host range, including species belonging to Asteraceae, Boraginaceae, Brassicaceae, Cannabaceae, Colchicaceae, Cornaceae, Fabaceae, Lamiaceae, Linaceae, Poaceae, Polygonaceae, Ranunculaceae, Rosaceae and Salicaceae (Bradley *et al*. 1973, Ferguson 1994, Fazekas & Szeőke 2011, Jung *et al*. 2011, Kontev 1972, Razowski 1959, West 1985). This species is a pest on cereal crops including wheat, barley, rye, oat and triticale (Güllü *et al*. 2014, Kontev 1972, Kontev *et al*. 1991, Meijerman & Ulenberg 2000). *Different larval* instars of *C. pasiuana cause* distinct types of *damage:* young larvae feed on the parenchyma of leaves of the host plants, forming long mines along the veins while the older larvae fold the leaves and form webbing cocoons inside, from which they feed on the leaf epidermis (Kontev 1972, Kornilov & Kositsyna 1981). The pest was found in Bulgaria for the first time in 1967 in a barley crop in the village of Rakovski, Dobrich region (Kontev 1969), later reported from the regions of Silistra, Shumen, Varna (Genkov *et al*. 1977) and it is known from several other localities (Zlatkov unpublished data). Until now several different sex attractants are known for this species. Firstly, Gigon (1980) reported about attraction of males of this species in the region of Neuchâtel, Switzerland to Funamone® (Zoecon, USA), which is probably a 98: 2 mixture of (*Z*)-8-dodecenyl acetate (*Z*8-12Ac) and (*E*)-8-dodecenyl acetate (Mayer & McLaughlin 1991). Ismailov *et al*. (1989) reported that *Z*9-12Ac and *E*9-12Ac in combination with dodecenyl acetate (1: 1.5: 2.5 ratio, dosage 2000 µg) attracted *C. pasiuana* in Krasnodar region, Russia. The same authors recorded attractancy of binary mixtures of *Z*9-12Ac and *E*9-12Ac in 1: 1 (dosage 1000 µg) and 1: 1.5 (dosage 1000 µg) ratios but they showed lower activity than the ternary mixture. During testing in several countries of selected combinations of the pheromone components of *Agrotis segetum* ([Denis & Schiffermüller], 1775) (Noctuidae), (*Z*)-5-decenyl acetate (*Z*5-10Ac), (*Z*)-7-dodecenyl acetate (*Z*7-12Ac) and (*Z*)-9-tetradecenyl acetate, Tóth *et al.* (1992) established that *C. pasiuana* males were captured by *Z*5-10Ac + *Z*7-12Ac in Sweden. Recently, Nässig (2008) established a different attractant lure for this species in Germany – a combination of (*E,E*)-8,10-dodecadienyl acetate and *Z*8-12Ac.

The purpose of our study was to investigate the seasonal flights of *E. formosana*, *R. resinella* and *C.*

pasiuana in traps baited with commercial pheromone lures containing a mixture of *E*9-12Ac and *Z*9-12Ac in the region of Sofia, Bulgaria, and to obtain information about species composition of Tortricidae captured by the pheromone traps in this region.

Pheromone traps are more sensitive and specific than other types of sampling system, and trap design is important parameter in optimising a trapping system to monitor a target species (Cardé & Elkinton 1984). The design of the traps used to detect flying insects varies highly but generally there are two main types of pheromone traps – sticky and non-sticky. We compared the efficacy of two trap types: sticky RAG (Delta type) and dry VARL+ covered funnel CSALOMON® pheromone traps for catching tortricid moths.

Material and Methods

Traps and lures

In 2008–2010, RAG traps CSALOMON® (Plant Protection Institute, CAR HAS, Budapest, Hungary, www.csalomontraps.com) with transparent PVC foil with a sticky layer (16 x 10 cm) at the bottom were used. VARL+ traps CSALOMON® were used only in 2010. Pheromone lures were supplied by Plant Protection Institute, CAR HAS, Budapest, Hungary and they contained *Z*9-12Ac and *E*9-12Ac in a ratio of 1: 1 (300 µg dosage).

Field trials

The field trials were organised at two sites in Sofia:

Botanical Garden (Bulgarian Academy of Sciences): On 9 May 2008 four baited sticky RAG traps were set on young *P. sylvestris* trees at a height of about 1.5 m. The traps were inspected weekly or in two-week intervals until 15 October 2008. Lures were replaced with fresh ones once per month. The distance between the traps was 50-100 m. Many different native and exotic tree and shrub species of both angiosperms and gymnosperms were presented in this area. No management practices were done at this site.

Training and Experimental Field Station (University of Forestry) in Vrazhdebna: In 2009, four baited sticky RAG traps and two unbaited (control) sticky RAG traps were set on trees at a height of 1.5 m in an mixed (*Cerasus, Malus, Prunus*) orchard (1.5 ha). The monitoring period was from 9 April until 15 October 2009. Two sticky RAG traps and two VARL+ dry covered funnel traps were set in the field on 13 April and operated until 2 September 2010. All traps were rotated in a clockwise manner after each inspection, and all lures were replaced with fresh ones once per month. The traps were visited at 5-10 days intervals. In 2009 and 2010 a m*ixed crop* of common vetch (*Vicia sativa* L.) and oats (*Avena sativa* L.) grown for forage, a vineyard, and a nursery of gymnosperms (*Thuja* L., *Pinus* L.) and angiosperms (*Acer* L., *Fraxinus* L., *Quercus* L., *Tilia* L.) were the neighbour fields of the orchard. In order to maximize yields, weeds around the bases of the fruit trees in the orchard were suppressed by mowing and water through irrigation tubing was added regularly.

Identification of the species captured in the traps was performed on the basis of their external morphological characteristics and the structures of male genitalia. The following sources were used for species identification: Kuznetsov (1978), Razowski (1959, 2002, 2003), Langmaid & Agassiz (2010). Systematics and nomenclature follow Aarvik (2013).

Statistical analysis

A paired *t*-test was used to establish a possible significant difference between catches of *E. formosana* caught in sticky RAG traps and VARL+ dry funnel traps in Vrazhdebna in 2010. Trap catch data were transformed to square root [x + 0.5] before the analysis. Statistics were done using SPSS 19.0.0 for Windows (IBM Corporation, USA 2010).

Results

During the three-year study a total of 978 moths of the family Tortricidae belonging to 16 species were captured in the traps (Table 1). All species with the exception of two *T. viridana* moths, which were caught in unbaited traps, were caught in traps with a pheromone lure.

Two tortricid species were recorded in the Botanical Garden in 2008: the pine resin-gall moth *R. resinella* and the cherry bark tortrix *E. formosana*, the latter one being more abundant. In addition, four specimens of *Agrochola* (*Leptologia*) *lota* (Clerck, 1759) (Noctuidae) were recorded in the period 1-8 October 2008. A total of 16 tortricid species were established in the traps and most numerous species were *C. pasiuana* and *E. formosana* in Vrazhdebna Training and Experimental Field Station in 2009 and 2010. Seasonal flights of *E. formosana, R. resinella* and *C. pasiuana* are presented on Figs. 1-3.

Enarmonia formosana

The first catches of *E. formosana* males in the pheromone traps in the Botanical garden in 2008 were established for the period 13-20 May and the most numerous catches were registered at the end of June – beginning of July. The last catches were found at the first decade of October. In Vrazhdebna in 2009 the

Table 1. Catches of lepidopteran species in traps baited with a mixture of *Z*9-12Ac and *E*9-12Ac and unbaited traps in Sofia, 2008-2010

Species	Number of moths caught (months of collection)			Total
	Botanical Garden 2008	Vrazhdebna 2009	Vrazhdebna 2010	
Tortricidae, Tortricinae				
Cnephasiini				
Cnephasia abrasana (Duponchel, 1843)		1 (V)		1
Cnephasia communana (Herrich-Schäffer, 1851)		2 (V)	1 (V)	3
Cnephasia incertana (Treitschke, 1835)		2* (VI)		2
Cnephasia pasiuana (Hübner, [1796-99])		251 (VI-VIII)	113 (VI-VII)	364
Cnephasia stephensiana (Doubleday, 1849)		1 (VI)		1
Tortricini				
Tortrix viridana Linnaeus, 1758		5** (VI)		5
Tortricidae, Olethreutinae				
Enarmoniini				
Enarmonia formosana (Scopoli, 1763)	455 (V-X)	54 (V-VIII)	44 (VI-VII)	553
Eucosmini				
Epinotia tedella (Clerck, 1759)		2 (IV)		2
Retinia resinella (Linnaeus, 1758)	38 (V-VII)		2 (V)	40
Grapholitini				
Dichrorampha plumbana (Scopoli, 1763)			1 (V)	1
Dichrorampha (?) *sedatana* Busck, 1906		1 (V)		1
Grapholita funebrana (Treitschke, 1835)			1 (VII)	1
Grapholita lobarzewskii (Nowicki, 1860)			1 (VI)	1
Pammene argyrana (Hübner, [1796-99])			1 (IV)	1
Pammene giganteana (Peyerimhoff, 1863)		1 (IV)		1
Pammene (?) agnotana Rebel, 1914		1 (V)		1
Noctuidae, Noctuinae				
Agrochola (Leptologia) lota (Clerck, 1759)	4 (X)			4

? Doubtful identification
* All specimens were males with exception of one *C. incertana* moths
** All specimens were caught in the baited traps with exception of two males of *T. viridana* moths caught in the unbaited ones.

flight of *E. formosna* was observed from the second half of May to the end of September. The periods of the highest catches were at the middle of June and in August. In 2010, the flight period of the cherry bark tortrix was shorter: from the beginning of May to the end of July (Fig. 1).

Retinia resinella

The beginning of the flight of the pine resin-gall moth was missed in 2008 because of the late installing of the traps. Catches of males were recorded from the beginning of May to the second half of July 2008 (Fig. 2). No catches of *R. resinella* were recorded in Vrazhdebna in 2009. Only two specimens of this species were observed for the period of 5-12 May 2010 in a RAG sticky trap.

Cnephasia pasiuana

Cnephasia pasiuana moths were captured only at Vrazhdebna experimental station.The catches of adults of this species in 2009 were registered from 8 June to 12 August, and the maximum of the flight was in the second half of June. In 2010 the earliest catches of C. *pasiuana* males were recorded in the period of 10-18 June and the latest ones – on 22 July (Fig. 3).

In 2010 when we compared sticky RAG traps with dry VARL+ funnel traps baited with the same pheromone lures, the s*ticky traps* captured a higher number of tortricid leafrollers than the dry ones. Only two specimens of *E. formosana* and a single *C. communana* (Herrich-Schäffer, 1851) male moth were caught in the funnel traps. The mean catch of *E. formosana* moths in sticky RAG traps was significantly higher than in VARL+ funnel traps (t = 3.82; df = 17; P = 0.001).

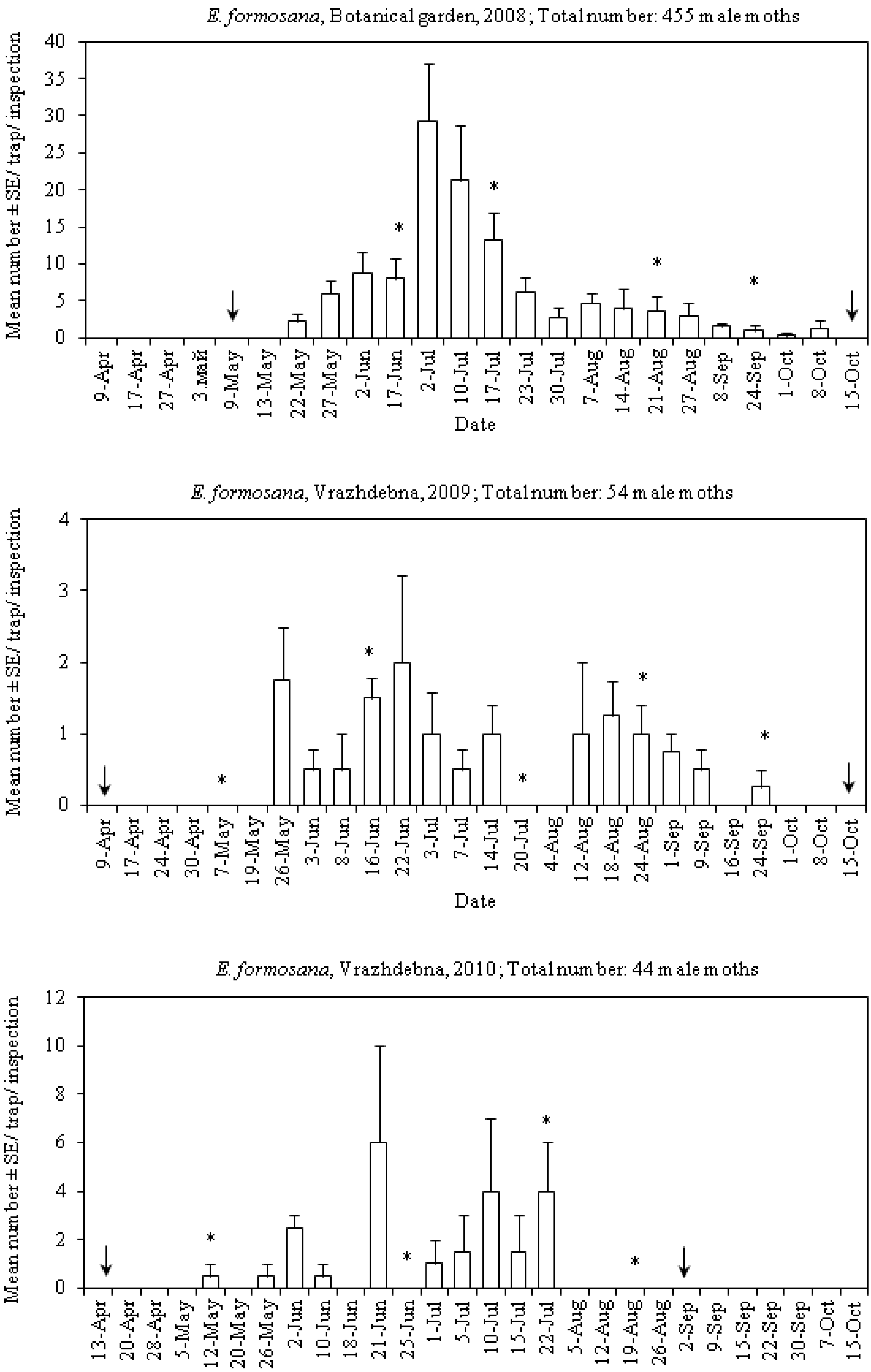


Fig. 1. Catches of *E. formosana* males in baited sticky RAG traps in the Botanical garden (four replicates) and Vrazhdebna (two replicates), Sofia, 2008-2010. For each year arrows (↓) show the starting and finishing date of the study and asterisks (*) - the dates when baits were renewed

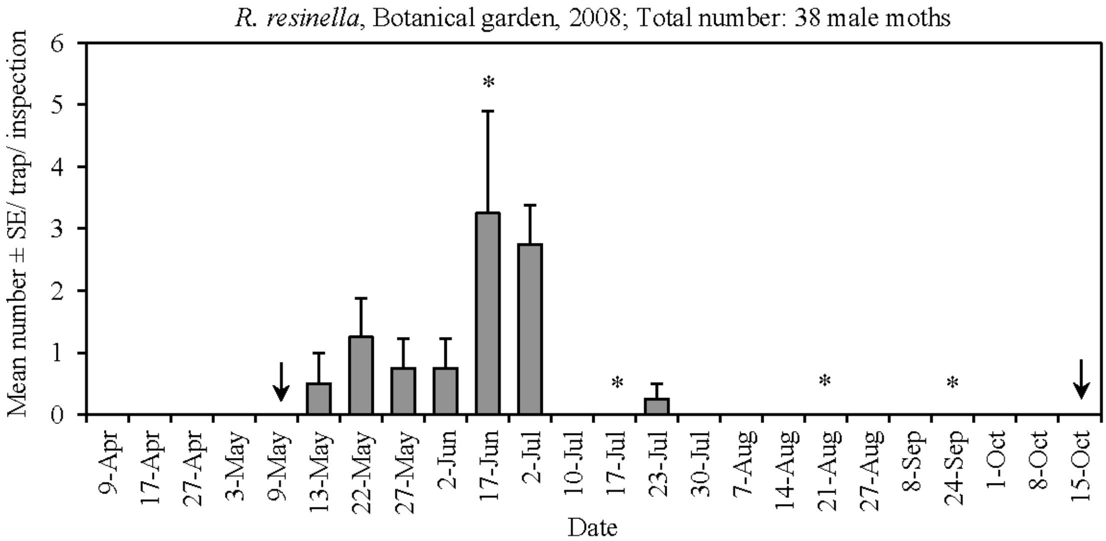


Fig. 2. Catches of *R. resinella* males in baited sticky RAG traps in Botanical garden (four replicates), Sofia in 2008. Arrows (↓) show the starting and finishing date of the study and asterisks (*) - the dates when baits were renewed

Discussion

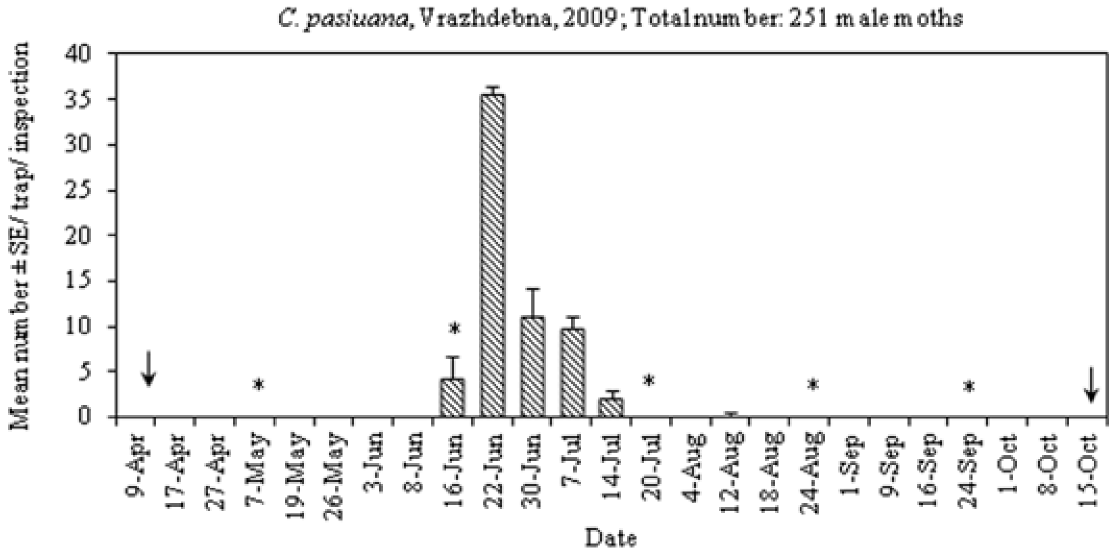
During our study we established attraction of three harmful tortricid species to commercial pheromone lures containing the mixture of *E*9-12Ac and *Z*9-12Ac (1:1) in the region of Sofia, *E. formosana, R. resinella* and *C. pasiuana*, and actual information about their seasonal flight was presented. The study is also the first to provide information about the seasonal flights of these species using pheromone traps in Bulgaria.

Enarmonia formosana

There is an inconsistency about the voltinism of the cherry bark tortix in the literature: and based on flight activity data, *E. formosana* is described as both univoltine and bivoltine (see Breedveld & Tanigoshi 2007, Jenner *et al*. 2004). The more precise investigation of Jenner *et al*. (2004) based on larval head capsule width measurements provides strong evidence for the occurrence of only one generation per year in Central Europe. Chayka *et al*. (2014) reports one generation of *E. formosana* with two peaks of flight in Ukraine but the flight period is shorter than this recorded in Bulgaria by us (May – August). Using pheromone traps Drosu (2001) and Marin *et al*. (2009) reports two generations of the cherry bark tortrix in Romania, and the period of the flight has been April – September during 1996 – 1998 and from the beginning of June till the beginning of September in 2008, respectively. In Poland the majority of the *E. formosana* moths begin to fly in the second half of May and according to the weather conditions the flight continues for 3-4 months (Pluciennik *et al*. 1996). In Hungary the species flies in two generations, the first in May – June, the second in July-August (Mészáros 1993). According to Bradley *et al*. (1979), adults of the cherry bark tortrix fly in June and July in Great Britain and sometimes later. In Seattle, USA, *E. formosana* flight has been recorded by pheromone trapping from the first half of May till the middle of September (Breedveld & Tanigoshi 2007).

Observations of Dirimanov & Sengalevich (1962) on the biology of *E. formosana* in field conditions have shown that this species has one generation per year in Bulgaria and overwinters as larvae of various ages. The moths fly from the end April to the end of September with two peaks of flight. The moths developed from the mature overwintered larvae fly in April - June and the maximum of the flight is in June, while the moths emerging from less-mature overwintered larvae fly in July – September and the peak of the flight is in August. Our results showed quite a long flight of the cherry bark tortrix in the region of Sofia: from the beginning of May till the first decade of October. *Traps catches* indicated a large peak of flight of male moths at the end of June – beginning of July during 2008 – 2009 and well-defined second peak were observed in August 2009.

During our study mean trap catches of the cherry bark tortrix in the Botanical garden were higher than that in Vrazhdebna field station. This could be explained by the application of management practices in the orchard in Vrazhdebna field station. Studies by Dickler & Zimmermann (1972) on the biology and population dynamics of *E. formosana* in Germany showed that the removal of grass and weeds growing around the trees had an effect on the temperature and humidity around the lower part of



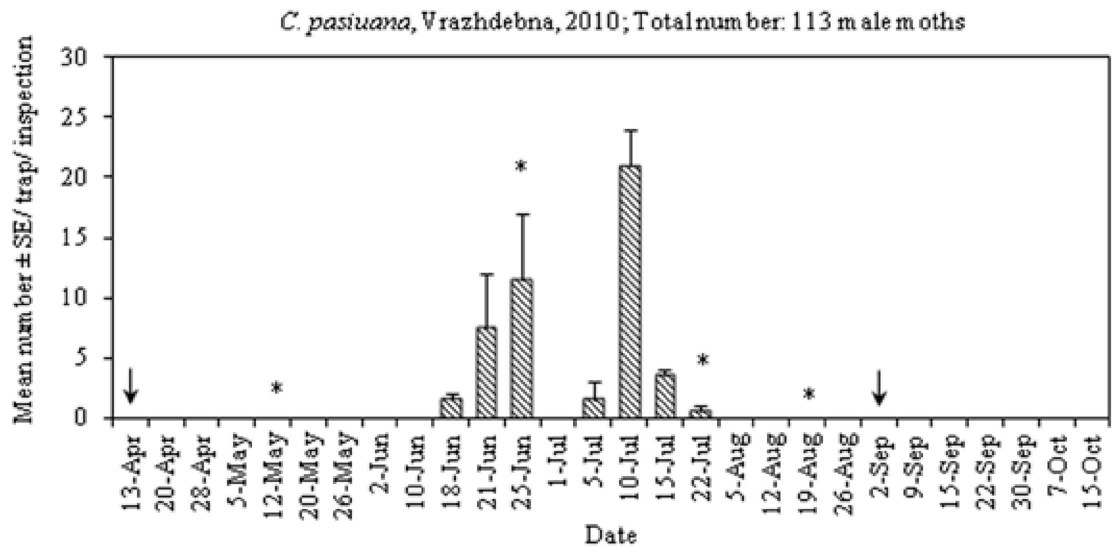


Fig. 3. Catches of *C. pasiuana* males in baited sticky RAG traps in Vrazhdebna (two replicates), Sofia in 2009-2010. For each year arrows (↓) show the starting and finishing date of the study and asterisks (*) - the dates when baits were renewed

the trunk and resulted in reduction in larval density of infested trees.

Retinia resinella

The pine resin-gall moth *R. resinella* is a periodical species and normally has a two-year life cycle in most parts of its range, while at higher latitudes and altitudes the moth shows a three-year life cycle (Heliövaara & Väisänen 1988, Heliövaara *et al.* 1994). In Central Europe (Czech Republic) *R. resinella* fly from the end of May to the end of June (Weiser & David 1997), while in northern European countries (Finland) adults fly in late June – early July (Heliövaara 1986). In Great Britain *R. resinella* moths fly in June (Bradley *et al.* 1979). Usual flight period in Hungary is May – June (in the mountains till July) (Szabóky & Csóka 2010). In the area where *R. resinella* completes one generation for two years the moths fly almost exclusively in even years (Heliövaara & Väisänen 1988). According to Zashev & Keremidzhiev (1968) and Tsanova *et al.* (1979), in Bulgaria this species develops one generation for two years, and the moths fly in May and June. The results of our study confirmed these data, however some specimens were observed also in July.

Cnephasia pasiuana

In his work about European species of Cnephasiini (Tortricidae) Razowski (1959) wrote that *C. pasiuana* adults could be observed from the middle of May to the end of July. In Crimea the flight period of this species is from the second decade of May to the middle of July, while mass emergence of the moths is in late June (Budashkin 2009, Kornilov & Kositsyna 1981). According to Fazekas & Szeőke (2011*)* the moths fly in late May and June in Hungary. In Great Britain and Russia (Krasnodar) the adults of the pest fly in June and July (Bradley *et al*. 1973, Bland *et al*. 2014, Ismailov *et al*. 1989). In Bulgaria this species develops one generation (Kontev 1972, 1973) and the seasonal flight of the adults starts at the end of June and the peak of the flight is in the first half of July (Grigorov 1972). Our results showed an earlier appearance of moths of *C. pasiuana* in the region of Sofia and earlier peak of flight in 2009: from the second decade of June and in the second half of June, respectively. To the best of our knowledge, there *are no* previous reports on the occurrence of *C. pasiuana* in the region of Sofia.

A number of trap and lure parameters, including the attractant composition and dosage, dispenser type and longevity, trap design and colour, height and trap placement, ability to retain the insects after the capture and saturation of trap with insects can influence detection and *monitoring* programs (Cardé & Elkinton 1984). Our results showed that catches of *E. formosana* and *C. pasiuana* were highly influenced by the design of traps and that the sticky traps are more effective in capturing males of the both species than the funnel traps. Trap design was not studied previously as a specific factor influencing the captures of *C. pasiuana* males to the sex attractant trap. In the case of *E. formosana* our results coincided with the statement of Tóth *et al.* (2008), that the funnel trap design is not suitable for capture of this the pest giving, however, no concrete data. Traps with a sticky trapping surface are often used for small insects, such as smaller moths and scale insects (Suckling & Karg 2000). Sticky traps including several different models, two-litre milk-carton Delta traps, Delta sticky traps and Diamond sticky traps (Phero Tech Inc.) and Red Atracon A Delta traps, are used for monitoring and for mating disruption of *E. formosana* (Breedveld & Tanigoshi 2007, Liblikas & Kuusik 2006, McNair 1999a, 1999b). Similarly to our results, sticky Delta traps were much more effective in capturing of males of the potato tuber moth *Phthorimaea operculella* (Zeller) (Gelechiidae) (Subchev *et al*. 2013) and the lesser date moth *Batrachedra amydraula* Meyrick (Batrachedridae) (Al-Jorany *et al*. 2015) than the funnel ones. However, the funnel trap was significantly more attractive than Delta, Pherocon 1C, and Pherocon II traps for male *Palpita unionalis* (Pyralidae) (Athanassiou *et al*. 2004).

The most of the other 12 tortricid and one noctuid species caught during our study are widespread in Bulgaria with exception of the small fruit tortrix, *Grapholita lobarzewskii* (Nowicki, 1860), a species similar to *E. formosana* in wing coloration (Kopec, Przybylowicz 2001). This species causes damage on apples and plums, mainly in Central and Western Europe (Sauter, Wildbolz 1989). In Bulgaria, this species is rare and it has been reported from Kostinbrod and Pancharevo only (Velcheva 2001).

Conclusions

Transparent sticky pheromone CSALOMON® traps baited with of *E*9-12Ac and *Z*9-12Ac (1:1) proved potential tool for detection and seasonal monitoring of *E. formosana*, *C. pasiuana* and *R. resinella* in Bulgaria.

In the region of Sofia, Bulgaria, the seasonal flight activity of *E. formosana* occured from the beginning of May till the first decade of October. The seasonal activity of *R. resinella* moths was in May and June, but some catches were found in July as well. The flight of *C. pasiuana* started from the second decade of June and lasted till the end of July – beginning of August.

Sticky RAG traps were more effective in capturing *C. passiuana* and *E. formosana* than dry VARL+ funnel traps baited with the same pheromone lure.

Monitoring by means of pheromone traps can help in decision making about application of pest control measures against *E. formosana*, *C. pasiuana* and *R. resinella*.

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