Bulgarian Journal of Agricultural Science, 22 (No 2) 2016, 272–277
Agricultural Academy

SPECIES DIVERSITY OF PARASITODS REARED FROM CODLING MOTH, CY*DIA POMONELLA* (LINNAEUS 1758) AND PLUM FRUIT MOTH, *GRAPHOLITA FUNEBRANA* (TREITSCHKE 1835) (LEPIDOPTERA, TORTRICIDAE) IN BULGARIA

N. VELCHEVA[1] and A. ATANASSOV[2]
[1] *Agricultural Academy, Institute of Soil Science, Agrotechnologies and Plant Protection, BG-1331, Sofia, Bulgaria*
[2] *Rutgers, the State University of New Jersey, USA*

Abstract

VELCHEVA, N. and A. ATANASSOV, 2016. Species diversity of parasitods reared from codling moth, *Cydia pomonella* (Linnaeus, 1758) and plum fruit moth, *Grapholita funebrana* (Treitschke, 1835) (Lepidoptera, Tortricidae) in Bulgaria. *Bulg. J. Agric. Sci.*, 22: 272–277

Studies on species diversity and rate of parasitism of larval and pupal parasitoids, of two major tree fruit pests, codling moth *Cydia pomonella* (Linnaeus, 1758) and plum fruit moth *Grapholita funebrana* (Treitschke 1835) were conducted in Bulgaria. Eighteen larval or pupal parasitoids were reared from codling moth and 7 larval or pupal parasitoids from plum fruit moth belonging to 5 and 2 Hymenoptera or Diptera families, respectively. Two parasitoids of the codling moth and five parasitoids of the plum fruit moth are new host records for Bulgarian fauna.

Levels of parasitism ranged from 0.74% to 3.7%, and 0 to 4.9% of diapausing codling moth and fruit plum larvae, respectively. The highest percentages of parasitism were recorded for the first generation of plum fruit moth (5.7% - 7.6%) and in an event of very low fruitlessness of apple trees for codling moth (33. 3%). The guild of primary solitary larval endoparasitoids of both pests was the most numerous.

Key words: parasitoids, rate of parasitism, *Cydia pomonella* , *Grapholita funebrana* , parasitoids, guilds

Introduction

We conducted this study to define species diversity and rate of parasitism of larval and pupal parasitoid assemblages of codling moth, *Cydia pomonella* (Linnaeus, 1758) and plum fruit moth, *Grapholita funebrana* (Treitschke, 1835). Needs to update our knowledge in this trend are in connection with preserving biodiversity in orchards, developing integrated pest management, and organic fruit production.

The list of naturally occurring parasitoids of codling moth larvae and pupae as far as we found in Bulgarian entomological literature included 12 braconids, 11 ichneumonids, 2 pteromalids, and 2 tachinid flies (Table 1).

Prior to the year 1995 six parasitoid species of plum fruit moth of which 2 species of Braconidae and 4 of Ichneumonidae have been reported (Table 2).

Materials and Methods

Larvae and pupae of codling moth were collected from corrugated cardboard bands placed on tree trunks and from damaged fruits in Sofia region (Western Bulgaria) located at 595 m a. s. l., 42°49" N and 23°23"E in 1998-2002 and 2005-2008. Larvae of plum fruit moth were collected from damaged fruits or corrugated cardboards with cotton belted on tree trunks in conventionally sprayed or organic plum orchards in

**E-mail:* nyonkavelcheva@gmail.com; atanas5@hotmail.com

Table 1

List of larval and pupal parasitoids of *Cydia pomonella* Linnaeus 1758 reported in Bulgaria before 2012

Family	Species	Author (s)
Braconidae	*Cremnops desertor* (Linnaeus 1758)	Atanassov, Slavov, 1978
	Bassus rufipes (Nees 1812)	Balevski et al., 1958
	Ascogaster quadridentana (Wesmael 1835)	Balevski et al., 1958
	Ascogaster rufipes (Latreille 1809)	Balevski et al., 1958
	Chelonus starki (Telenga 1953)	Ivanov, Slavov, 1976
	Macrocentrus thoracicus (Nees 1811)	(Balevski, 1995)
	Macrocentrus marginator (Nees 1811)	Atanassov, Slavov, 1978
	Apanteles emarginatus (Nees 1834)	Atanassov, Slavov, 1978
	Apanteles sodalis (Haliday 1834)	Atanassov, Slavov, 1978
	Microgaster meridiana (Haliday 1834)	Peeva et al., 2009
	Aleiodes bicolor (Spinola 1808)	Peeva et al., 2009
	Rhyssalus pomonellae (Atanasov 1996)	Atanasov, 1996
Ichneumonidae	*Itoplectis maculator* (Fabricius 1775)	Atanassov, 1978
	Pimpla rufipes (Miller 1759)	Atanassov, 1978
	instigator Fabricius 1793	
	Pimpla spuria Gravenhorst 1829	Atanassov, 1978
	Pimpla turionellae Linnaeus 1758	Atanassov, 1978
	Pimpla arcadica (Kasparyan 1973)	Kolarov, 1997
	Liotryphon caudatus (Ratzeburg 1848)	Atanassov, 1978
	Liotryphon punctulatus (Ratzeburg 1848)	Atanassov, 1978
	Ephialtus extensor	Balevski et al., 1958
	Phygadeuon varicornis (Gravenhorst 1829)	Atanasov, 1981
	Hemiteles bipunctator (Thunberg 1824)	Atanassov, 1978
	Pristomerus vulnerator (Panzer 1799)	Atanassov, 1978
	Trichomma enecator (Rossi 1790)	Balevski, 1976
Pteromalidae	*Dibrachys affinis* (Masi 1907)	Ivanov, Slavov, 1976
	Dibrachys microgastri (Bouché 1834)	Ivanov, Slavov, 1976
	boucheanus Ratzeburg 1844	
	zelleri Ratzeburg 1844	
	cavus Walker 1835	
	vesparum Ratzeburg 1852	
	clisiocampae Fitch 1856	
	boarmiae Walker 1863	
	elegans Szelenyi 1981	
Tachinidae	*Elodia morio* (Fallen 1820)	Balevski et al., 1958
	Exorista fasciata (Fallen 1820)	Velcheva et al., 2012

Table 2

List of larval and pupal parasitoids of *Grapholita funebrana* (Treitschke 1835) reported in Bulgaria before 1995

Family	Species	Autor(s)
Braconidae	*Ascogaster quadridentana* (Wesmael 1835)	Tosheva, 1960
	Apanteles laspeyresiellus (Papp 1972)	Balevski, 1995
Ichneumonidae	*Lissonota carbonaria* Holmgren 1860 (=*Lissonota artemisiae* Ischek)	Tosheva, 1960
	Enytus apostatus (Gravenhorst 1829) (=*Enytus exarelatus* Ratzeburg 1852, *Angitia* (*Dioctes*) *exareolata* Ratz.)	Tosheva, 1960
	Liotryphon punctulatus (Ratzeburg 1848)	Atanassov, 1986
	(=Ephialtus extensor Taschenberg 1863)	Tosheva, 1960
	Ephialtes nov. sp.	Tosheva, 1960

experimental orchards of Agricultural University, near Plovdiv (Central Southern Bulgaria) at 160 m a. s. l., 42°9“ N and 24°45“E in 2006-2009. Insufficient numbers of plum fruit moth larvae or pupae were collected in an abandoned plum orchard in Sofia region (Velcheva et al., 2010) due to irregular fruitfulness caused by winter or spring frost injury, lack of pruning and spray program.

Damaged plum fruits with larvae in were held in wooden boxes with netting lids under laboratory conditions. Rolls of cotton and corrugated cardboards were placed over fruits to facilitate pupation. In cases of doubt for the pest, fruits were held individually in plastic cups. Emergence of parasitoids or pests· moths were checked up on daily basis. Bands with diapausing larvae of codling moth· and plum fruit moth were kept in rooms at t of 0°C to 5°C and moistened regularly.

Emerged parasitoid species were determined following keys of Kasparyn et al. (1981) and Tobias et al. (1986). The taxonomic status and nomenclature of parasitoids follow the European fauna catalogue (http://www.faunaeur.org).

Terminology of parasitoid guilds follows Mills (1992).

Table 3. Larval and pupal parasitoids reared from Cydia pomonella Linnaeus 1758

Family	Species (guild, emergence, distribution*, note when applicable)
Braconidae	1. ***Ascogaster quadridentata*** (Wesmael 1835) solitary egg-larval endoparasitoid, emerged at beginning of May to the end of August. Europe, Afro-tropical region, Neotropical region, Oriental region, introduced into North America.
	2. ****Ascogaster rufidens*** (Wesmael 1835) solitary, egg-larval parasitoid, emerged in second half of June. Europe. Develops 2-3 generations in year (Zerova et al., 1989).
	3. ***Macrocentrus thoracicus*** (Nees1811) primary, solitary larval endoparasitoid, emerged second decade of Mai-first decade of June. Palaearctic , Nearctic region, Oriental region.
	4. ****Apanteles corvinus*** (Reinhard 1880) primary, solitary larval endoparasitoid, emerged first decade of May. Europe, Caucasus, Canada.
	5. ***Apanteles sodalis*** Haliday 1834 (=Apanteles ater (Ratzeburg, 1852) primary, gregarious larval endoparasitoid, emerged end of May. Palearctic.
	6. ***Apanteles emarginatus*** (Nees 1834) primary solitary larval endoparasitoid. emereged in August. Europe, Azarbaidzhan, Turkey.
	7. ***Bassus rufipes*** (Nees 1812) primary, solitary larval endoparasitoid emerged end of May - June, July to the beginning of August. Europa, Asia. Introduced in California.
Ichneumonidae	8. ***Pimpla spuria*** (Gravenhorst 1829) primary solitary pupal endoparasitoid, rare secondary, emerged second half of May and August. Europe, Near East, North Africa, Oriental region, Sofia and Plovdiv region.
	9. ***Pimpla turionellae*** (Linnaeus 1758): primary, solitary, pupal endoparasitoid, emerged end of May- June, August. Europe, Nearctic region, North Africa, Oriental region.
	10. ***Liotryphon caudatus*** (Ratzeburg 1848) primary, solitary, ectoparasitoid of cocooned prepupal larvae, emerged second half of June-August. Europe, Near East, Oriental region.
	11. ***Liotryphon punctulatus*** (Ratzeburg 1848) primary, solitary ectoparasitoid of cocooned prepupal larvae emerged in April and in end of July-August. Europe.
	12. ***Pristomerus vulnerator*** (Panzer 1799) primary solitary, larval endoparasitoid , emerged April- May, July –August. Europe, Near East, North Africa, Oriental region.
	13. ***Trichomma enecator*** (Rossi 1790), primary, solitary, larval-pupal endoparasitoid emerged May and August. Europe, Near East, Oriental regon.
	14. ***Mesochorus sp.*** solitary, secondary, cocoon parasitoids, emerged in May and August.
	15.***Gelis sp:*** solitary, secondary parasitoid. emerged in beginning of April and second half of August.
Pteromalidae	16. ***Dibrachys microgastri*** (Bouché 1834) (= *D. boucheanus* Ratzeburg 1844 = *D. cavus* Walker 1835 = *D. vesparum* Ratzeburg 1852 = *D.elegans* Szelenyi, 1981 = *D. boarmiae* Walker 1863 = *D.clisiocampae* Fitch 1856,= *D. zelleri* Ratzeburg 1848) primary and secondary, gregarius prepupal larvae and pupal ectoparasitoid. Europe, Asia, North America.
Perilampidae	17. ***Perilampus fulvicornis*** (Ashmead 1886) solitary, secondary parasitoid of Ascogaster quadridentana (Wesmael 1835). Europe.
Tachinidae	18. ***Elodia morio*** (Fallen 1820) primary, solitary larval endoparasitoid, emerged in end of April-May and second half of July to beginning of September. Europe.

*Distrubution of species follows Fauna Europaea 2000 – 2013 (http://www.faunaeur.org);
Kaspryan et al, 1981; Kolarov, 1997; Tobias et al., 1986; Zerova et al, 1989
**New recorded host-parasitoid relation for Bulgaria,

Results and Discussion

Cydia pomonella (Linnaeus 1758)

Totally, 18 parasitoid species were reared from larvae and pupae of codling moth belonging systematically to 5 families (Table 3). The amount of Ichneumonidae and Braconidae species were close in numbers. Eight reared species (5 primary and 3 secondary) belonged to 5 subfamilies of Ichneumonidae and seven species to 4 subfamilies of Braconidae (Table 3). Host-parasitoid relations between codling moth and braconid wasps *Ascogaster rufidens* (Wesmael 1835) and *Apanteles corvinus* (Reinhard 1880) are new records for Bulgaria. *Ascogaster quadridentata* (Wesmael, 1835) (Braconidae, Cheloninae) and *Pristomerus vulnerator* (Panzer, 1799) (Ichneumonnidae, Cremastinae), were predominant species during the years of investigation.

In this study, primary solitary larval endoparasitoids prevailed in the recorded parasitoid complex of codling moth (Figure 1). Similar results were observed in our previous study on parasitoid assemblages of ectophagous Lepidoptera in abandoned apple orchard situated in Sofia region (Velcheva and Atanassov, in print).

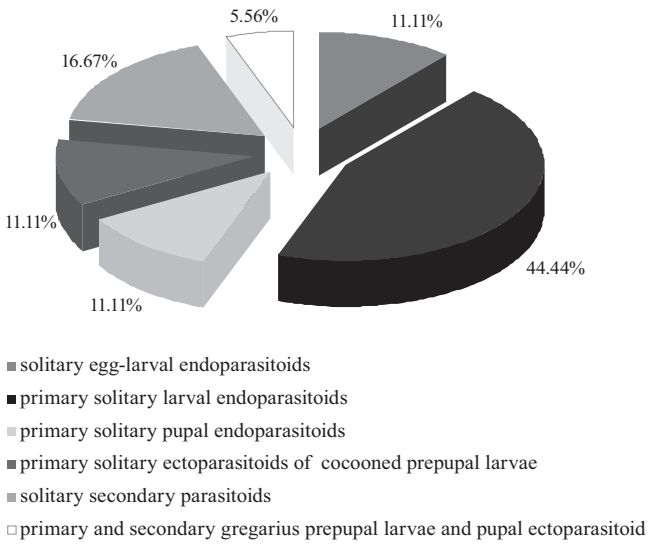

Figure 1. Structure of parasitoid guilds of *Cydia pomonella*

Rate of parasitism of diapausing larvae of codling moth ranged in low values, 0.74% - 3.7%. One only exception was observed in 2008 when fruitfulness was extremely low and we hardly found three only trees to bind bands on trunks in an abandoned apple orchard near the city of Sofia. Then, the mean number of larvae was 6 per band and the rate of parasitism reached 33. 3%

Grapholita funebrana (Treitschke 1835)

Seven parasitoid species were reared from larvae and pupae of *G. funebrana* with very high prevailing of species belonging to family Ichneumonidae (Table 4). *G. funebrana* is a new host for *Pimpla spuria* (Gravenhorst, 1829), *Pimpla turionellae* (Linnaeus, 1758), *Liotryphon caudatus* (Ratzeburg, 1848) *Pristomerus vulnerator* (Panzer 1799) and *Diadegma armillata* (Gravenhorst, 1829) in Bulgaria. Similarly to the rates of codling moth parasitoid guilds, primary solitary larval endoparasitoids of plum fruit moth were the most numerous (Figure 2).

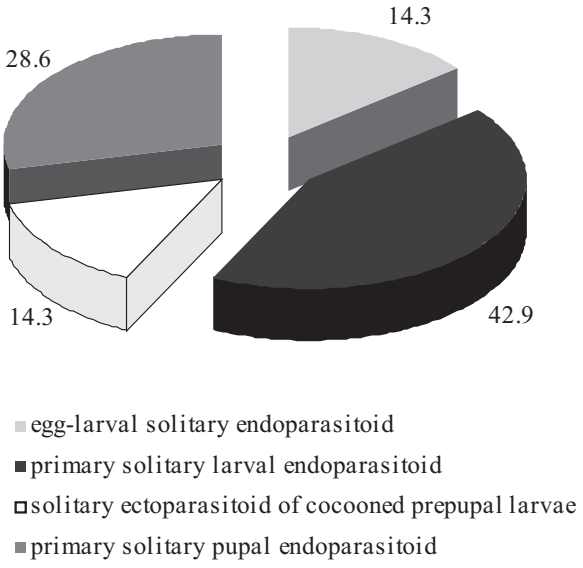

Figure 2. Structure of parasitoid guilds of *Grapholita funebrana*

The cosmopolitan braconid *Ascogaster quadridentata* (Wesmael 1835), reared from larvae of plum fruit moth collected from the both observed regions, was the most abundant species. Similar statements were concluded by Tosheva (1960) in Bulgaria, Bovey (1966) in France, Saparmamedova (1988, 1988a,) in Turkmenistan, and Batinica and Muratovich (1972) in former Yugoslavia. *Ephialtes* new sp., *Angitia* (*Dioctes*) *exareolata* (*=Enytus exareolatus* Ratzeburg, 1852), *Liotryphon punctulatus* (Ratzeburg, 1848) (*=Ephyaltes extensor* Taschb.), and *Apanteles laspeyresiellus* (Papp, 1972) previously reported by Tosheva (1960), Atanasov (1986), and Balewski (2009) (Table 2) have not been reared from plum fruit moth in this study.

Rate of parasitism of diapausing larvae of plum fruit moth was low and ranged from 0.0 to 4.9%.

First generation larvae collected and reared in damaged fruits demonstrated the highest rate of parasitism ranged within 5.7 and 7.6%.

Table 4

Larval and pupal parasitods reared from *Grapholita funebrana* (Treitschke 1835)

Family	Species (guild, emergence, distribution*, note when applicable)
Braconidae	1. ***Ascogaster quadridentata*** (Wesmael 1835) egg-larval solitary endoparasitoid emerged at beginning of May to the end of August. Places of collections- organic orchard of AU Plovdiv, abandoned plum orchard and untreated plum trees near Sofia. Europe, Afro-tropical region, Neotropical region Oriental region introduced into North America
Ichneumonidae	**2. ***Pimpla spuria*** (Gravenhorst 1829) primary, solitary, pupal, endoparasitoid emerged in May-August, of treated plum orchard of AU Plovdiv. Europe, North Africa, Oriental region.
	3. ***Pimpla turionellae* (Linnaeus 1758) primary, solitary, pupal endoparasitoid abandoned plum orchard Pancharevo, Sofia region, emerged end of May - June. Europe, Nearctic region, North Africa, Oriental region.
	4. ***Liotryphon caudatus* (Ratzeburg 1848) solitary ectoparasitoid of cocooned prepupal larvae , Plovdiv, treated plum orchard, emerged 3.05. 2009. Europe, Near East, Oriental region.
	5. ***Pristomerus vulnerator* (Panzer 1799) primary solitary, larval endoparasitoid abandoned plum orchard Sofia region, emerged April- May, July - August. Europe, Near East, North Africa, Oriental region.
	6. ***Diadegma armillata* (Gravenhorst 1829), primary, solitary larval endoparasitoid, emerged end of May (23. 05. 2009), Plovdiv treated orchard. Palearctic, Australia, Near East, Oriental region.
	7. ***Lissonota (Lissonota) carbonaria*** (Holmgren 1860) primary solitary larval endoparasitoid , emerged in August. Europe, Azerbaijan, Turkey and China (Kolarov, 2008)

*Distrubution of species follows Fauna Europaea 2000 – 2013 (http://www.faunaeur.org);
Kaspryan et al, 1981; Kolarov, 1997; Tobias et al., 1986; Zerova et al, 1989
**New recorded host-parasitoid relation for Bulgaria,

Conclusions

Eighteen parasitoid species were reared from larvae and pupae of codling moth, *Cydia pomonella* (Linnaeus,1758) and seven parasitoid species from larvae and pupae of plum fruit moth, *Grapholita funebrana* (Treitschke, 1835) belonging to 5 and 2 families, respectively.

Two new codling moth-parasitoid relations and 5 new plum fruit moth-parasitoid relations were recorded for Bulgarian fauna in this study.

Dominants parasitoids reared from *Cydia pomonella* (Linnaeus, 1758) were *Ascogaster quadridentata* (Wesmael, 1835) and *Pristomerus vulnerator* (Panzer 1799) and the same braconid wasp prevailed in parasitoid larval and pupal complex of *Grapholita funebrana* (Treitschke, 1835)

Rate of parasitism ranged from 0.7% to 3.7%, and 0.0% to 4.9% of diapausing larvae of codling moth and plum fruit moth, respectively. Most likely, those are not entirely correct values of parasitism due to very high mortality of the pest larvae we observed during the overwintering caused by low temperatures, fungi, granolosus viruses, bacteria, microsporidia and other entomopathogens.

The highest percentage of parasitism was recorded of the first generation of plum fruit moth and of the codling moth in an event of very low fruitlessness of apple trees.

We suggested that the list of parasitoids infesting larvae and pupae of codling moth and plum fruit moth in Bulgaria is not completed yet. Studies have to be extended in the main fruit growing regions to clarify parasitoid role as a mortality factor in various ecological conditions.

Acknowledgements

The authors are grateful to Prof. Zdravko Hubenov, Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria for identification of *Elodia morio* (Fallen, 1820) (Diptera, Tachinidae).

References

Aitken, A. D., 1963. A key to the larvae of some species of Phycitinae (Lepidoptera, Pyralidae) associated with stored products, and of some related species. *Bulletin of Entomological Research*, **54** (2): 175–188.

Atanassov, A. Z., 1978. Les parasites de *Carpocapsa pomonella* L. en Bulgarie et leur role dans la regulation de la densité des population, Colloque Franco Bulgare, Bordeaux, pp. 55–64.

Atanasov, A. Z., 1981. A contribution to the studies of insects of family Ichneumonidae (Hymenoptera) in Bulgaria. *Acta Zool. Bulgarica*, **18**: 87–89.

Atanassov, A. Z., 1986. An annotated list of the parasites (Ichneumonidae, Hymenoptera) on the pests in Bulgaria. *Bull. IOBC, East Paleartic Section*, **14**: 7–19.

Atanasov, A. and N. Slavov, 1978. Les parasites de *Carpocapsa pomonella* L en Bulgarie et leur role dans regulation de la densité des populations. Lutte integer vignoble et en verger. Colloque Franco-Bulgarre, 26–28 Septembre, 1978, Sofia, pp. 55–64.

Atanasov, A., 1996. A new for the ectoparasitic fauna species on the caterpillars of the codling moth (Laspeyresia pomonella L.-Rhyssalus pomonellae sp. now (Hymenoptera, Braconidae). *Acta Entomologica Bulgarica*, **1**: 55–64.

Balevski, A. D., 1976. Integrated management of diseases and pests in apples. *Plant Protection*, 9: 28–30.

Balevski, A. D., At. N. Wasev, Sp. Hr. Ivanov, Ass. Lazaroff and Zw. T. Zwetkowa. 1958. Die Obstmade (*Laspeyresia pomonella*). Biologie, Oecologie und Masnahmen zur Bekämpfung und Möglichkeiten zur Einfűrung des Warndienstes. Wissenschaftliche Abhandlungen, Bd1, pp. 108–158.

Balevski, N., 1995. New phytophagous hosts of hymenopterous braconid parasitoids (Hymenoptera, Braconidae) in Bulgaria. *Acta Entomologica Bulgarica*, 2: 69–73.

Batinica, J. and S. **Muratovic,** 1972. Importance of the plum moth (*Grapholitha funebrana* Tr.) for the plum variety 'Bilska rana'. *Zastita Bilja*, **3** (117/118): 11–12.

Bovey, P., 1966. Super-famille des Tortricoidea. Les carpocapse des prunes. In: A. S. Balachowsky *Entomologie appliquée à l'agriculture*, Ed. Masson et Cie, Paris, **2** (1): 746–763.

Fauna Europaea, http://www.faunaeur.org.

Diky, S. Ki Yo, 1997–2012. Home of Ichneumonoidea.
http://www.taxapad.com

Ivanov, Sp. and N. Slavov, 1976. Possibilities of using *Dibrachus affinis* against codling moth. *Plant Protection*, 30–31.

Kasparyan, D. R. (ed.), A. Z. Atanassov, V. P. Ionaitis, V. S. Kuslitzkij, A. P. Rastnicin, U. V. Sijtan and V. I. Tolkanic., 1981. Key to determination of insects of the European part of the USSR, V 3, Hymenoptera, No129, Leningrad, "Nauka", 688 pp. (Ru).

Kolarov, J., 1997. Fauna Bulgarica, 25 Hymenoptera, Ichneumonidae. Part I. Pimplinae, Xoridinae, Acaenitinae, Collyriinae. *Editio Academica "Prof. Marin Drinov"*, *Editio "PenSoft"*, 326 pp.

Kolarov, J. A., 2008. Catalogue of the [former] Yugoslavian Ichneumonidae (Hymenoptera, Insecta) *Linzer Biol. Beitr.*, **40** (2): 1585–1739.

Mills, N. J. 1992. Parasitoid guilds, life-styles, and host ranges in the parasitoid complexes of tortricoid hosts (Lepidoptera: Tortricoidea). *Environmental Entomology*, **21** (2): 230–239.

Papp, J., 1972. New Apanteles Forst. species from Hungary (Hymenoptera, Braconidae: Microgasterinae) *I. Annales Historico-Naturales Musei Nationalis Hungarici*, **64**: 335–345.

Peeva, P., **N. Velcheva and N. Balevski,** 2009. New braconid parasitoids (Hymenoptera: Braconidae) isolated from lepidopterian pests in apple orchards in Bulgaria. *Plant Science*, **46** (4): 346–350.

Saparmamedova, N. K., 1988. On the study of natural enemies of the plum moth *Grapholitha funebrana* Tr. (Lepidoptera, Tortricidae) in the Prikopetdag zone. *Izvestiya Akademii Nauk Turkmenskoi SSR. Seriya Biologicheskikh Nauk*, **4**: 40–43.

Saparmamedova, N. K., 1988a .The role of entomophages in reducing the numbers of the plum tortricid in the foothill zone of the Koptedag. *Izvestiya Akademii Nauk Turkmenskoi SSR. Seriya Biologicheskikh Nauk*, **3**: 34–38.

Tobias, V. I. (ed.), S. A. Elokobil'skij and A. G. Cotenko., 1986. Key to determination of insects of the European part of the USSR. V 3, Hymenoptera, No145, *Nauka*, Leningrad, 500 pp. (Ru).

Tosheva-Tzvetkova, Tz., 1960. The biology and control of the red plum maggot Grapholitha (*Laspeyresia funebrana* Tr. (Lep.). *BAS*, *CNIIZR*, Scientific Works, vol. III, pp. 203–228.

Velcheva, N., A. Atanassov. Parasitoid assemblages of ectophagous lepidopteran complex on abandoned and untreated apple trees (*Malus domestica* Borkhausen) from Western Bulgaria. *Plant Sci.,* (in print).

Velcheva, N., A. Atanassov, P. Peeva, N. Balevski, O. Karadjova, Y. Kolarov, V. Pelov, Z. **Hubenov,** 2010. Parasitoid assemblage of external-feeding lepidoptera in an abandoned plum orchard in West Bulgaria. *J. of Balkan Ecology*, **13** (4): 405–416.

Velcheva, N., A. Atanassov, O. Karadjova and Z. Hubenov, 2012. Parasitoid assemblages reared from externally-feeding Lepidoptera and codling moth (*Cydia pomonella* L., Tortricidae) in young apple orchard in West Bulgaria. *Bulgarian Journal of Agricultural Science*, **18** (5): 675–681.

Received June, 5, 2015; accepted for printing February, 19, 2016