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**Parasitoid Complex of the European Pine Shoot Moth  
[*Rhyacionia buoliana* (Denis & Schiffermüller 1775)]  
[Lepidoptera: Tortricidae] in the Lakes District of Turkey**

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(Received: November 4, 2015 and Accepted: December 22, 2015)

**ABSTRACT**

The parasitoid complex of the European shoot moth [*Rhyacionia buoliana* (Denis & Schiffermüller 1775)] the important defoliator on *Pinus brutia* forests in Turkey was studied in the Lakes District of the South-western of Turkey. Shoots with *R. buoliana* larvae and pupae were collected in 2013 and 2014 and examined under laboratory conditions. Eight parasitoid species on *R. Buoliana* were recorded; *Actia resinellae* Schrank (Dip.: Tachinidae), *Brachymeria munita* Linnaeus, *B. tibialis* Walker (Hym.: Chalcididae), *Exeristes roborator* Fabricius, *E. ruficollis* Gravenhorst, *Pimpla turionellae* Linnaeus (Hym.: Ichneumonidae), *Monodontom erusaereus* Walker and *Torymus calcaratus* Ness (Hym.: Torymidae). *B. munita* and *P. turionellae* were the most frequent. Total parasitism on the *R. buoliana* reached 21.3 and 16% in 2013 and 2014, respectively. Among the recorded species, *E. ruficollis* was a new record in Turkish fauna.

**Key words:** *Rhyacionia buoliana*, parasitoids, parasitism, Lakes District, Turkey.

**INTRODUCTION**

*Rhyacionia buoliana* (Denis & Schiffermüller 1775) [Lepidoptera: Tortricidae] has wide distribution area in the world. It spreads from 60<sup>th</sup> latitude in the northern hemisphere to 30<sup>th</sup> latitude in the southern hemisphere. It exists from the Pacific coasts to the Atlantic Ocean in American continent and it can be found in all pine forest stands having suitable climatic conditions in almost all northern hemisphere from England to Japan in Europe and Asia (Mol, 1987; Ide and Lanfranco, 1996; Heeley et al., 2003).

Presence of this moth in Turkey has been known since 1941 (Bodenheimer, 1941). It was identified for the first time in the Marmara region in Turkey and then in Istanbul, Bursa, Ankara, Burdur, Isparta, Izmit, Kahramanmaraş, Kayseri regions of Turkey and on *Pinus brutia* Ten., *P. nigra* Arnold, *P. pinaster* Ait., *P. pinea* L., *P. halepensis* Mill. and *P. radiata* D. Don (Acatay, 1943; Schimitschek, 1944; Beşçeli, 1969; Tosun, 1977 and Mol, 1987).

Pine shoot moth is one of the most harmful insect species of pine trees in Turkey. The larvae enter into buds by drilling themselves and cause damage by engraving inside the buds. The damaged buds dry or grow with an abnormal shape called as "Post Horn". Sometimes, the formations such as bushes, tufts and the brush-shaped or as double post horn occur (Çanakçıoğlu and Mol, 1998).

Parasitoids have an important role in reducing *R. buoliana* population density. Therefore, the present study dealt with the parasitoids' complex of *R. buoliana* in the Lakes District of Turkey and their parasitism rate on the pest species.

**MATERIALS AND METHODS**

The studies were conducted in the research sites of the Brutianpine forests, have the age of 25-30 years and similar features that located in Isparta-Gonen, Isparta-Atabey, Afyonkarahisar-Dinar and Burdur-Bucak in the Lakes District, situated in the South western part of Turkey where damages by *R. buoliana* were found in 2013 and 2014.

Larvae and pupae were collected from the research sites between mid-May and mid-July in both years at weekly intervals. Larvae collected from shoots of damaged pine trees were brought to the laboratory for feeding by placing them into plastic containers under room conditions (21-24 °C) until reaching pupal stage. Besides, collected pupae from the study sites were observed daily until parasitoids' adult emerge. Specimens from the emerged parasitoids were placed into plastic eppendorf tubes, emerging dates were recorded and parasitism rate was calculated according to the number of emerged adults. Emerged parasitoids were identified by specialists.

**RESULTS AND DISCUSSION**

A total of 8 parasitoid species recovered from the pupae of *R. buoliana* were identified. These were: *Actia resinellae* Schrank (Dip.: Tachinidae), *Brachymeria munita* Linnaeus, *B. tibialis* Walker (Hym.: Chalcididae), *Exeristes roborator* Fabricius, *E. ruficollis* Gravenhorst, *Pimpla turionellae* Linnaeus (Hym.: Ichneumonidae), *Monodontom erusaereus* Walker, *Torymus calcaratus* Ness (Hym.: Torymidae). Out of these species, *E. ruficollis* was a new record for Turkish fauna.

Through field and laboratory observations

Table (1): Parasitoid species and parasitism rates on *Rhyacionia buoliana* collected from the Lakes District, South western part of Turkey in years 2013 and 2014

Species	Month	Parasitism %									
		2013 (No. of pupae)					2014 (No. of pupae)				
		Atabey	Dinar	Koçtepe	Ürkütlü	Total	Atabey	Dinar	Koçtepe	Ürkütlü	Total
		65	55	50	55	225	110	95	75	70	350
<b>DIPTERA</b>											
<b>Tachinidae</b>											
<i>Actia resinellae</i> (Schrank 1781)	July	-	-	-	-	-	-	2.7	-	-	0.6
<b>HYMENOPTERA</b>											
<b>Chalcididae</b>											
<i>Brachymeria minuta</i> (Linnaeus 1767)	July	12.3	7.3	-	5.5	6.7	6.4	5.3	-	2.9	4
<i>Brachymeria tibialis</i> (Walker 1834)		7.7	3.6	-	3.6	4	6.4	4.2	-	-	3.1
<b>Ichneumonidae</b>											
<i>Exeristes roborator</i> (Fabricius 1793)	July	-	9.1	-	-	2.2	-	3.2	-	-	0.8
<i>Exeristes ruficollis</i> (Gravenhorst 1829)	July	6.2	-	-	-	1.8	3.6	-	-	-	1.1
<i>Pimpla turionellae</i> (Linnaeus 1758)	June-July	7.7	3.6	8	3.6	5.8	6.4	6.5	4	4.3	5.5
<b>Torymidae</b>											
<i>Monodontom erusaereus</i> Walker	July	-	-	-	-	-	2.7	-	-	-	0.9
<i>Torymus calcaratus</i> (Ness 1834)	July	-	-	4	-	0.9	-	-	-	-	-
Total parasitism rate (%)		33.9	23.6	12	12.7	21.4	25.5	19	6.7	7.2	16
Emergence rate of <i>R. buoliana</i> (%)		63	70.9	78	81.8	72.8	70.9	74.7	85.3	85.7	78
<b>Pupal mortality (%)</b>		3.1	5.5	10	5.5	5.8	3.6	6.3	8	7.1	<b>6</b>

conducted in 2013 and 2014, some species emerged only in one year while some others were recorded in both years. Total parasitism of the parasitoid species on the population of *R. buoliana* was estimated by 21.4% in 2013 as a result of collecting a total of 225 pupae obtained from larvae brought from the field to the laboratory. Correspondent value was 16% according to the parasitoid adults collected from 350 pupae in 2014 (Table 1).

In 2013, out of 225 pupae collected from the 4 research sites, 164 (72.8%) *R. buoliana* adults emerged and 13 (5.8%) failed to emerge. Besides, a total of 48 (21.3%) parasitoid individuals emerged. In 2014, out of 350 pupae collected, 273 (78%) of *R. buoliana* adults emerged and 21 (6%) failed to emerge. Besides, a total 56 (24.9%) parasitoid individuals were obtained. All species were recovered as solitary parasitoids.

*B. minuta*, represented by (6.7%) in 2013, was the most frequent parasitoid species recovered from *R. buoliana*, while in 2014, *P. turionellae* (5.4%) was the most frequent one. Highest parasitism rates 33.9% (out of 65 pupae) in 2013 and 25.5% (out of 110 pupae) in 2014 were recorded from the pupae collected from Atabey research site in both years. Dinar research site came second in the parasitism rate by 23.6 and 19% in 2013 and 2014, respectively. Among the parasitoid species, *P. turionellae* was found in all the research sites, while *A. resinellae* and *T. calcaratus* were found only in Koçtepe, *E. roborator* only in Dinar and *E. ruficollis* and *M. aereus* only Atabey.

Between the years 1928-1958, Schröder (1978) recorded 13 parasitoid species in Canada. In a study carried out between the years 1954 to 1956 in Ontario, Canada on *R. buoliana*, Watson and Arthur (1958) stated that one species from Diptera and 22 species from Hymenoptera were found on 10% of the insect population. Between the years 1970-1972, Kearby and Taylor (1975) recorded 23 species of parasitoids from Missouri, USA. Mol (1987) reported in a study conducted in Turkey, that the most frequent parasitoid species was *Tetrastichus turionumat* with a parasitism rate of (14-30%). Also, the ichneumonids; *Ephialtes sagax* Htg., *Itopectis alternans* Grav., *Pimpla turionella* L., *Campoplex* sp., *Perilampus tristis* Mayr. (Hym.: Perilampidae), *Orgilus obscurator* Ness (Hym.: Braconidae), *Actia resinellae* Schrank (Dip.: Tachinidae) were recorded in the same study.

In the present study, *P. turinella* and *R. buoliana* had the highest parasitism rates among the surveyed parasitoid species in 2014. Ryan and Medley, (1970) and Szmidt and Luterek, (1983) reported that these species were polyphagous pupal parasitoids of forest tree pest species and they parasitized some lepidopterans pests which were harmful for many host plants.

Fahringer (1922), Özdemir and Kılınçer (1990), Yurtcan and Beyarslan (2005), Gürbüz (2004) and Çoruh (2005) stated in their studies, conducted in Turkey, that *P. turionellae* was found in Bursa, Istanbul, Kırklareli, Erzurum, Ankara, Eskisehir, Konya, Nevsehir and Isparta vicinities. Çoruh (2005)

also recorded the species of *Coleophora laricella* (Hbn.), *Aegerias coliaforme* (Bkh.) and *Typhia fomes* (Bkh.) as hosts of this parasitoid. Among the hosts of *Monodontom erusaereus* in Turkey, (Oğurlu, 2000) reported *Archips rosana*, *Euproctis chrysorrhoea*, *Lymantria dispar* and *Choristoneura murinana*. *B. tibialis* was found as a parasitoid of *Hyphan triacunea* (Drury), *Lymantria dispar* (L.), *Tortrix viridana* (L.), *Archips rosana* L., *A. xylosteana* L. and *Leucomas alicis* L. in previous studies (Baş, 1980 and Öymen, 1982).

*Exeristes roborator* was stated to be found in Elazığ, Erzincan, Malatya and Tunceli and *Lixus utilis*, *L. bardanae*, *Larinus turbinatus*, *L. canescens*, *L. sturnus*, *L. onopordi*, *L. latus*, *L. canescens*, *Rhinocyllus conicus*, *Pectinophora gossypiella*, *Anthonomus pomorum*, *Biorhiza pallida*, *Bupalus piniarius*, *Dendrolimus pini*, *Ostrinia kasmirica*, *O. nubilalis*, *Pyrausta varialis*, *Pontania viminalis*, *Choristoneura murinana*, *Cydia pomonella*, *Yponomeut amalinella*, *Y. padella*, *Y. rorrella* were detected to be its hosts (Beyarslan and Erdoğan, 2009).

Consequently, the parasitoid species complex of *R. buoliana*, the pest of young pine fields in Turkey, was found to be relatively effective on the pest population. Further studies related to natural enemy species and the possibilities of their usage within the scope of biological control programs should be investigated.

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