Egg parasitoids of *Lobesia botrana* (Den. & Schiff.) (Lepidoptera: Tortricidae) in the vineyards of Izmir and Manisa Provinces in Turkey

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Abstract. The study was carried out to determine egg parasitoids of *Lobesia botrana* (Den. & Schiff.) on Sultani Cekirdeksiz grape in Izmir and Manisa between 2009–2011. Both eggs found on grape berries in vineyards and the eggs reared in the lab and mounted onto bunches were used to determine egg parasitoids. Minimum 50 lab-reared eggs were mounted at the level of bunches in each vineyard. These eggs were re-collected after 2–4 days and maintained in the climate room for checking daily if parasitized. Parasitism rate by *Trichogramma euproctidis* Girault (Hymenoptera: Trichogrammatidae) on mounted *L. botrana* eggs was determined as 8% in conventional vineyard of Sarıgöl in 2009, whereas it was found 10.91% in conventional vineyard of Salihli, 5% in organic vineyard of Alaşehir and 1.33% in integrated vineyard of Menemen in 2010. Natural parasitism of *L. botrana* eggs on berries by *T. euproctidis* was determined as 10% and 16% in integrated vineyard of Alaşehir in 2009 and 2010, respectively. *T. euproctidis* parasitized 38.6% of eggs whereas *T. brassicae* (Bezdenko) parasitised 1.44% of eggs on the berries in 2011. *T. euproctidis* and *T. brassicae* have been determined on the eggs of *L. botrana* in the Aegean Region, Turkey for the first time.

1. Introduction

Turkey is a country suitable for growing many fruit species because of its favorable climatic conditions. Fruit production in Turkey is approximately 16 million tons per year, 4 million tons of it is grape. Half of the production (2 million tons) is table grape and 1.5 million tons is produced for drying. The rest (0.5 million ton) is used in wine production [29]. Sultani Çekirdeksiz (*Vitis vinifera* L.) grape variety is mainly produced in Manisa, Denizli and Izmir Provinces in Aegean Region and exported as fresh and dried.

Lobesia botrana (Den.-Schiff.) (Lepidoptera: Tortricidae) (European Grapevine moth) is the key pest of grape in the Aegean Region producing 3–4 generation per year. It causes direct injury by eating and makes punctures on flowers, blooms, unripe and mature grape berries. Additionally, it damages the crop since saprophytic fungi develop on grape juice leaking from punctured berries [27]. It causes damage between 45 and 92% on the crop if any preventive control method is applied [1]. In the world, researches are available on egg parasitoids of *L. botrana.* Especially the studies are available that releasing egg parasitoids is used in the control of *L. botrana* in alone or combined with mating disruption technique and biological preparations [3,12].

In Turkey, researches are available on larvae parasitoids of *L. botrana* and predatory species occurring in the vineyards [1,2,13,16,18,21,27]. However, data is unavailable on the determination of egg parasitoids in the vineyards. The aim of the research is to determine egg parasitoids of European Grapevine in the vineyards of Izmir and Manisa Provinces.

1.1. Material and method

Main material of the study are Sultani Çekirdeksiz grapes, eggs of *L. botrana* and its egg parasitoids. The study was carried out in Sultani Çekirdeksiz (*Vitis vinifera* L.) vineyards in Izmir and Manisa Provinces between 2009 and 2011 years.

The sampling vineyards have been selected especially from organic farming. In case of its unavailability, integrated and conventional vineyards have been selected, respectively. Preparations officially allowed in organic agriculture have been used against diseases and pests in organic vineyards. *Bacillus thuringiensis* preparations in the control of *L. botrana*, sulphur in the control of *Erysiphe necator* 'Sch'Burr. and *Colomerus vitis* Pgst. and copper in the control of *Phomopsis viticola* (Sacc.) Sacc.) and (*Plasmopara viticola* (Berk. Et M. A. Curtis) were used. If chemical control is necessary in integrated vineyards, the pesticides were selected among the less toxic preparations for the environment according to the principles in Grape Integrated Pest Management Instruction Book [27] by the official inspectors. Neither economic threshold nor pesticide selection have been taken into consideration in conventional vineyards by growers. Sampling vineyards were selected among the ones being minimum 0.5 ha in size and close to hedge plants, shrubs, forest and fruit trees where the parasitoids can overwinter [7,26]. *L. botrana* eggs laid by females on the berries in these vineyards were

Table 1. Number of detected parasitoids in eggs laid by *Lobesia botrana* (Den. & Schiff.) on the berries and parasitism rate (%) in integrated vineyard in Manisa-Alaşehir in 2009–2011.

Sampling Date	# of Eggs	# of Parasitoids*		Parasitism rate (%)	
		T. eup.	*T. bra.*	*T. eup.*	*T. bra.*
16.9.2009	50	5	0	10	0
17.9.2010	175	28	0	16	0
13.9.2011	207	80	3	38.6	1.44
Total	432	113	3	–	–

**T. eup.: Trichogramma euproctidis; T. bra.: Trichogramma brassicae.*

sampled every week. In each vineyard, totally 100 clusters were checked from different directions of randomly selected 25 grapevines. If determined, berries infested with egg were brought into lab and maintained one by one under the same lab conditions mentioned above. These eggs were checked daily under the stereomicroscope to determine parasitoids and parasitism rate. Adults parasitoids were sent to the expert for identification.

In addition, *L. botrana* eggs were obtained from lab-rearing culture in $25 \pm 1^{\circ}$C, in $60 \pm 10\%$ humidity and 16 h-light; 8 h-dark photoperiod (6). Eggs laid on gelatinous paper by females in the lab were brought to the sampling vineyards in an icebox. They were equally distributed into 3 vine trees and hanged at the height of bunches to increase the chance of obtaining egg parasitoids. Minimum 50-maximum 160 eggs were hanged in each sampling vineyard. These eggs were left on the vines 4, 2–3 and 3–4 days for the 1st 2nd 3rd and 4th generations, respectively. Then they were re-collected and brought to the laboratory in an ice box. These eggs will be mentioned in the Results and Tables as "infested eggs".

2. Results and discussion

Two egg parasitoids species were determined from *L. botrana* eggs. They were identified as *Trichogramma euproctidis* Girault and *T. brassicae* (Bezdenko) (Hymenoptera: Trichogrammatidae) (Table 1).

No egg parasitoids were determined from the eggs laid by *L. botrana* females on berries during the samplings conducted between May and August. When frequent sprayings are completed at late August, 50 eggs laid by 4th generation females were found on berries in the integrated vineyard in Manisa-Alaşehir on 16 September 2009. *T. euproctidis* adults (5 individuals) were obtained from these eggs in the lab and natural parasitism rate was calculated as 10%. Natural parasitism rate of *T. euproctidis* was determined as 16% in the same vineyard on 17 September 2010 (Table 1). Both *T. euproctidis* (80 ind.) and *T. brassicae* (3 ind.) adults were obtained from 207 *L. botrana* eggs collected from berries in the same vineyard on 13 September 2011. Natural parasitism rates were determined as 38.6 and 1.44%, respectively. The highest parasitism rate of the study was 38.6% and obtained from eggs laid naturally in this integrated vineyard (Table 1).

Egg parasitoid detected districts and vineyards, production system of the vineyard, number of eggs infested, number of obtained parasitoids and parasitism rates are given in Table 2. In 2009, 100 lab reared eggs of *L. botrana* were installed on the berries in the conventional vineyard in Sarigol District during the first generation of the pest. *T. euproctidis* (8 ind.) were determined and parasitism rate was found as 8% (Table 2). In 2010, 110 lab reared eggs of *L. botrana* were hanged on the berries in the conventional vineyard in Salihli District. *T. euproctidis* (12 ind.) were determined and parasitism ratio was found as 10.91%. *T. euproctidis* (5 ind.) were obtained from 100 eggs in the organic vineyard in Alaşehir whereas only one T. euproctidis adult was obtained from 75 eggs in the integrated vineyard in Menemen.

Table 2. Number of *Trichogramma euproctidis* Girault obtained from *Lobesia botrana* (Den. & Schiff.) eggs infested on berries and parasitism rate (%) in İzmir and Manisa in 2009–2010.

Province (District)	Syst*	Infesting date	# of Infested Eggs	# of Parasite	Parasitism %
Manisa (Sarıgöl)	Conv.*	12.5.09	100	8	8
Manisa (Salihli)	Conv.*	13.9.10	110	12	10.91
Manisa (Alaşehir)	Org.*	13.9.10	100	5	5
Izmir (Menemen)	Int.*	14.9.10	75	1	1.33
Total	–	–	385	26	–

**Syst: System of Production; Conv.:conventional, Org.: Organic, Int.: Integrated.*

In Turkey, [11] reported that seven *Trichogramma* species or ecotype were reared in the laboratory conditions on *Ostrinia nubilalis* Hbn. (Lepidoptera: Pyralidae) and *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae) eggs and the highest performance was detected on *O. nubilalis* eggs by *Trichogramma ostrinia* and *T. euproctidis* respectively. *T. evanescens* was determined in *Helicoverpa armigera* eggs (Hübner) (Lepidoptera: Noctuidae) on cotton and tomato plants in Manisa (Muradiye) [9], in *O. nubilalis* eggs on corn plant and in *H. armigera* eggs on cotton and cabbage plants, and on *Chrysodeixis chalcites* Esper. (Lepidoptera: Noctuidae) eggs on black nightshade in Adana, Mersin and Hatay [24], respectively. *T. evanescens* was obtained from *O. nubilalis* eggs on corn in Aydin-Cine, [5;4] and from *Idaea bractilineata* Zeller (Lepidoptera: Geometridae) eggs on Indian oil plant in Adana, Mersin, Hatay Provinces [24]. Additionally, [28] reported that *Trichogramma evanescens* Westwood (=*Trichogramma turkestanica* Meyer) (=*Trichogramma euproctidis* G.) was found on *L. botrana* eggs without detail. *T. brassicae* was found from *Traumatocampa ispartaensis* Doğanlar & Avcı (Lep. : Notodontidae) eggs on cedar in Isparta [20].

It is known that T*richogramma* species are successfully used in biological control of *L. botrana* [3,12,17,25] in the world [14] reported that *T. cacoeciae* Marchal, *T. daumalae* Dugast and Voegele, *T. evanescens* and *T. principium* Sugonjaev and Sorokina were determined in France and *Trichogramma* species became more active in the vineyards between April–May and June–September [10] stated that parasitism rate of *L. botrana* by *T. brassicae* is lower than other species. These results correspond to the results of our study. In France, [17] found that *T. evanescens* is more common than *T. cacoeciae*

during the first generation of *L. botrana* but *T . cacoeciae* is more efficient in the second generation of the pest. In Italy, *T. evanescens* is determined as egg parasitoids and caused 25% parasitism of *L. botrana* eggs [23]. Parasitism rate of *T. evanescens* reached 97% in Egypt and it was assumed as very important in the control of *L. botrana* [25].

The study showed that *T. brassicae* could parasitized *L. botrana* eggs in Turkey for the first time. However, *T. brassicae* (3 individuals) was only found in eggs on the naturally left small bunches in the vineyard during the fourth generation in September of 2011. The most common and efficient parasitoid is *T. euproctidis* in Sultani Çekirdeksiz vineyards of Izmir and Manisa. *T. euproctidis* was determined both from eggs laid by *L. botrana* females on berries and from lab reared eggs infested into the field. The parasitoid was determined both in the vineyards where the first generation of the pest in May is not sprayed due to low population density and in the vineyards where the fourth generation in September is not sprayed due to postharvest. It is considered that the parasitoid may decrease the pest population but is not sufficient to suppress in alone due to frequent chemical sprayings and moving away vineyard ecosystem for lack of host.

3. Conclusion

Egg parasitoids were found in Alasehir, Sarıgol, Salihli (Manisa Province) and Menemen (Izmir Province) districts during the study. Higher parasitism rate has been observed during periods of lower chemical sprayings. The presence of shrub, oak, olive trees near were the common characteristics of parasitoid determined vineyards. It was assumed that these vineyards provided food and overwintering grounds for the parasitoids. Additionally, plant diversity has contributed positively to the presence of parasitoids [8, 19, 22, 26].

In Turkey, some researches are available on larva parasitoids of *L. botrana* and predatory species occurring in the vineyards However, detailed work is unavailable on its egg parasitoids. It is expected that determination of *T. euproctidis* and *T. brassicae* would have a significant contribution to the biological control of *L. botrana*, the key pest, by the studies on the determination of effective rearing and releasing parameters due to the importance of grape export.

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