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Distribution of European Leaf Roller, *Archips rosanus* (L.) (Lep.;Tortricidae) Egg Masses on Different Apple Cultivars

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Abstract: The distributions of European leaf roller egg masses, deposited in 2001 and 2002, were examined on Stark Crimson, Stark Spure Golden and Misket cultivars of apple (*Malus communis* L.) in Eastern Mediterranean Region of Turkey. From 70-80% of the egg masses were found on main and secondary branches in the canopy of the trees. Regression model provided expected vertical distribution of total numbers of egg masses on all plant parts in several heights intervals. On main and secondary branches, females discriminated in ovipozition by laying more egg masses in the southern and eastern quadrant and 80-160 cm heights intervals rather than other parts and heights. There were statistically significant differences among the mean number of egg masses found on the three apple cultivars. The highest population of mean number of egg masses was found on Stark Crimson and Golden and the lowest population was on Misket.

Key words: European leaf roller, *A. rosanus*, apple, egg masses

INTRODUCTION

The European Leaf Roller (ELR), *Archips rosanus* (L.) (Lepidoptera:Tortricidae), first recorded in Turkey in 1901 (Staudinger and Rebel, 1901), is a native species to the Palearctic region but it is distributed all over the world except the far east and Siberia. It feeds on many hosts, including fruit trees, forest trees and some weeds (Bradley *et al*., 1973; Ali Niazee, 1977; Ulu, 1983; Doganlar, 1987). ELR is a primary or sometimes secondary pest on cherry orchards depending on the time and the location (Mayer and Beirne, 1974; Ali Niazee, 1977). The European leaf roller is univoltine, in Cakit Valley its life cycle starts with the larva hatching from over wintering eggs in late February (Doganlar, 2003). The young larvae move to opening buds and feed on both sides of new leaves. Sometimes they web, developing buds and young foliage to form feeding nests. The larval period is about 6-8 weeks. Pupation occur within the rolled and webbed leaves (Baggiolini, 1956; Kapidani and Duraj, 1991; Grichanov *et al*., 1994; Moreas and Netti, 1996; Pluciennik and Tworkowska, 2004). Pupation occur at the end of May and early June (in Southern Turkey). Adults emergence occurs in the second week of June and continues usually mid-August. Adults live for 2-4 weeks. Most egg laying occurs in June and July with an average of 71.66±17.10 eggs per female (Doganlar, 2003) the egg masses usually are found on tree trunks and major branches. It feeds on a large variety of shrubs and trees (Markelova, 1957; Ali Niazee, 1983; Ulu 1983; Doganlar, 2003).

The first instars larvae are more sensitive to environmental condition them other stages (Ali Niazee, 1977; Doganlar, 2003). For this reason eggs and 1st instars larvae are main factors in control of ELR (Ali Niazee, 1983). Vertical distribution of egg masses in three cultivars of apple trees, preference of branches in several heights and quadrants were studied in Pozanti District in Southern Turkey. The result obtained from the present study is pertinent to development of control strategies for ELR and egg-sampling methods for population studies and for prediction of damage by this insect.

MATERIALS AND METHODS

The study was conducted in Horticulture Research Center (POZMER) in Çukurova University in Pozanti district (Adana, Southern Turkey) in 2001-2002. The orchards is placed in 65 ha and 1120 m from see level. There are fruit trees of stone fruits and soft seeded ones and also it has vineyards. The apple variety (*Malus communis* L.) were cultivated in the orchards Stark Crimson, Stark Spure Golden (Golden) and Misket. All of these varieties are high-yielding and dwarf ones which are grown for commercial purposes. Their heights vary between 2-2.5 m. All the trees in the garden are watered by means of dripping irrigation. Fertilization, pruning and other practices in the orchards where the study was conducted are carried out on the trees simultaneously and homogenously.

The egg population of the pest was determined by counting the egg masses in the hibernation period of 2001. The trial was repeated in 2002. For this reason, the initial observations were made in January and February when the trees were dormant, without opening egg masses. The egg masses were counted on nine trees (totally 27 trees) of three varieties selected randomly. All the egg masses on the trees were counted and marked.

The number of egg masses in the height of the nine apple trees chooses was determined in order to detect their vertical distribution on the tree. The eggs were separated into groups in six height ranges for obtaining the relationships between them. In grouping of the egg masses, total number of the egg masses was used. As the varieties used in the study are dwarf ones, the parts of the plant at the height of 80 cm up from the ground was determined as the trunk and the parts between 80- 200 cm was determined as the canopy and the other parts higher than 200 cm were determined as the small branch in one years old. Best fit curve estimation was applied on the data obtained by means of SPSS 10.0 statistical package program and the curve with the highest significance was considered to the regression curve ($p \leq 0.05$).

In order to determine the quadrants and the plant sections where the ELR egg masses were laid and their direction, the tree surface was then divided into 4 main sections: The trunk; main branches, which are the branches that grow affiliated to the body; secondary branches, which grow out of the main branch; the twigs are the thin branches with a diameter of 1-3 cm (tillers of the previous year) and each sections were partitioned into 4 quadrants (directions): North, East, South and West. In this way all the egg masses on the tree were counted and the geographical directions and the tree sections where they were laid were recorded. In the analyses made on the mean egg masses laid on various directions and plant sections, variance analysis was applied (one-way ANOVA, ($p \leq 0.05$). The groups which display statistically significant differences in terms of their means were determined with Duncan test ($p \leq 0.05$) was also used in comparing the mean number of the egg masses of the varieties (one-way ANOVA, ($p \leq 0.05$). The groups which display statistically significant differences in terms of their means were determined with Duncan ($p \leq 0.05$).

RESULTS AND DISCUSSION

Archips rosanus (L.) lays its eggs in the form of masses. It was detected that the number of the eggs in masses varies between 1-3 and 113. Generally the number of the eggs in a mass is between 40-80 and the approximate number of eggs in each of the egg masses is 51.50±2.85 (n = 75) (Fig. 1). This data was taken as a base in the interpretation of the figures and the tables.

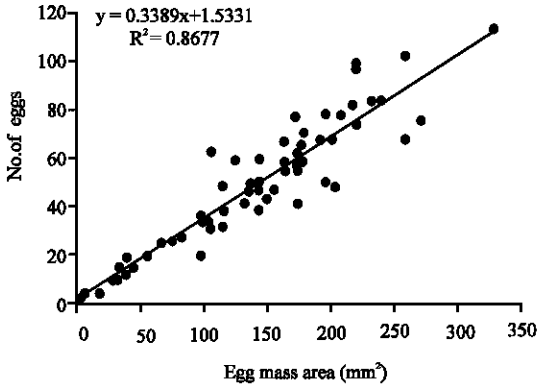

Fig. 1: Regression of numbers vs. mass area of field laid *A. rosanus* egg masses

The pest lays its eggs especially in the 80-160 cm height range in every two years. The number of the laid eggs decreases along the extremities from this height range. In all varieties and in all years, 70-80% of the eggs were laid on the canopy while only 20-30% of the eggs were laid on the trunk. In the case of stark crimson, the vertical distributions of the egg masses on tree were similar to each other. It was detected that the pest laids 48% of its eggs in the 80-160 cm range (Height interval) in 2001 and it laids 51% of its eggs in the 80-160 cm range in 2002. It laids 48% of eggs below 40 cm and above 200 cm in 2001 and laid 6% of its eggs below 40 cm and above 200 cm in 2001 and this rate was 8% in 2002. There was quadratic regression between the laid egg masses and their heights (2001 $F = 18.68950$, $p = 0.0203$; 2002 $F = 58.98769$, $p = 0.0039$). A similar distribution was observed in the Golden variety. Most of the eggs were laid on the canopy section. Few eggs were laid on the trunk. This is because of the fact that the trunk of the golden is not a favourable place for the pest to lay its egg as it has a cracked and split structure. In both years, most of the eggs were laid in the range of 80-160 cm, only 0-4% of the eggs was laid below 40 cm. In this variety, more eggs were laid in the height range of 160-200 cm, which is different from other varieties. There was quadratic regression between the laid egg masses and their heights (2001 $F = 14.55457$, $p = 0.0286$; 2002 $F = 9.80748$, $p = 0.0483$) (Fig. 2). When compared with other trees, fewer eggs were laid on Misket apple trees. Although more eggs were laid in the height range of 40-80 cm, the height range of 80-120 cm is the one where eggs can be laid more as it can be seen from the regression curve that was drawn for the purpose of estimating the relationship between the number of the egg masses and the height ranges. Quadratic regression best explains the relationship between the egg masses and the height ranges (2001 $F = 10.23557$, $p = 0.0457$; 2002 $F = 11.52888$, $p = 0.0391$) (Fig. 2).

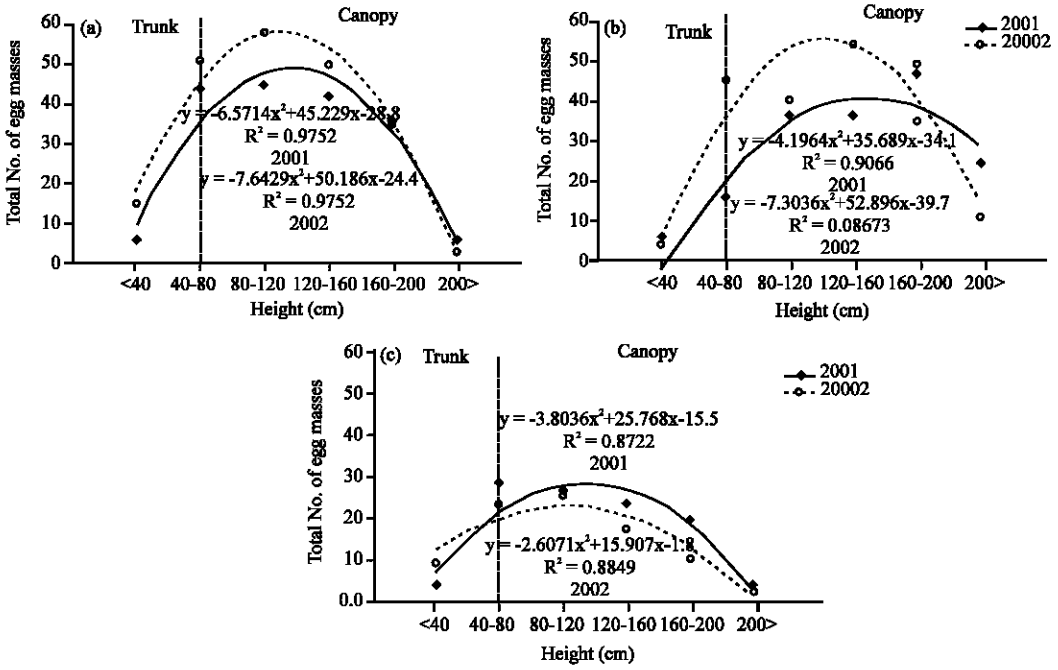

Fig. 2: Regression curves and equations of the expected number of *A. rosanus* egg masses on apple trees of (a) Stark Crimson, (b) Golden and (c) Misket in years of 2001-2002 (p = 0.05)

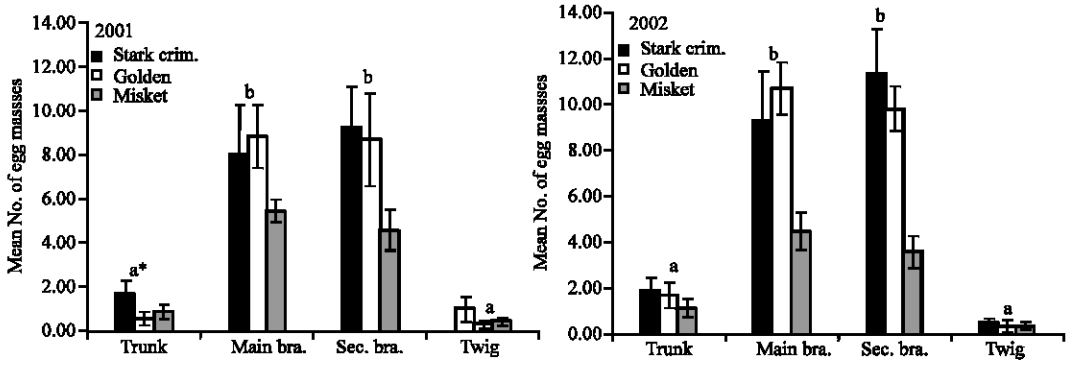

Fig. 3: Distribution of mean number of egg masses on plant parts for all apple trees. *Bar groups followed by the same letter are not significantly different at p<0.05 (Duncan test)

ELR laid more egg masses on main and secondary branches and less egg masses on trunk and twigs. This result was same in the both years and in the cultivars too. The statistical difference was determined on all varieties and each year (2001 Stark Crimson F = 8.121, df = 3,32, p = 0.0001; Golden F = 14.314, df = 3,32, p = 0.0001; Misket F = 20.658, df = 3,32, p = 0.0001; 2002 Stark Crimson F = 13.609, df = 3,32, p = 0.0001; Golden F = 44.666 df = 3,32, p = 0.0001; Misket F = 11.768, df = 3,32 p = 0.0001) (Fig. 3 and Table 1). Up to now it was stated that ELR has not laid eggs on twigs (Yıldırım, 1957; Ali Niazee, 1977; Ulu, 1983) but in this study some of the eggs were also found on twigs.

The varieties used in the study are the ones grown for commercial purposes. For this reason, most of the main branches and the thick sections of the secondary branches correspond especially to the height range of 80-160 cm. The results obtained from this study confirm the results of the vertical distribution. In addition, these sections constitute the points that are protected from the environmental factors more on the trees, which is why the pest may have preferred this point.

ELR preferred especially the southern sections to lay its eggs. It lays the eggs on the points that face the ground. The pest laid 47-48% of its eggs on stark crimson variety, 32-41% on the golden variety and 45-47% on the

Table 1: Mean No. of egg masses of ELR on different sides and plant sections of three different apple varieties (Stark Crimson, Golden, Misket) in 2001 and 2002

	Mean No. of egg masses (mean±SE)					
	2001			2002		
Parameters	Stark crimson	Golden	Misket	Stark crimson	Golden	Misket
Directions						
North	2.44±0.52a*	3.00±0.70a	1.88±0.26a	3.44±0.60a	3.66±0.78a	1.88±0.38
East	4.00±0.91a	4.33±1.00a	3.11±0.42b	4.44±0.60a	5.88±0.82a	2.00±0.44a
South	9.88±1.22b	5.22±1.09a	5.11±0.35c	10.66±1.36b	9.00±0.97b	4.55±0.44b
West	4.00±1.05a	3.44±0.68a	1.22±0.36a	3.88±0.67a	3.88±0.56a	1.22±0.22a
Part of plant						
Trunk	1.67±0.62a	0.56±0.29a	0.89±0.35a	1.88±0.53a	1.66±0.55a	1.11±0.39a
Main bran.	8.00±2.23b	8.78±1.40b	5.44±0.53b	9.22±2.15b	10.66±1.13b	4.44±0.80b
Sec. Bran.	9.22±1.76b	8.67±2.07b	4.56±0.90b	11.33±1.87b	9.77±0.96b	3.56±0.69b
Twig	1.00±0.57a	0.33±0.16a	0.44±0.18a	0.44±0.17a	0.33±0.23a	0.33±0.17a

*: Number in columns followed by the same letter are not significantly different at $p \leq 0.05$ (Duncan test)

Table 2: The mean number of egg masses on different apple cultivars in 2001-2002

				95% confidence interval for mean			
Cultivars	N	Mean	SE	Lower bound	Upper bound	Minimum	Maximum
Stark cri	9	19.88a*	2.48	14.15	25.62	12.00	36.00
Golden	9	18.33a	2.56	12.42	24.23	9.00	31.00
Misket	9	11.33b	0.66	9.79	12.87	8.00	14.00
Total	27	16.51	1.37	13.69	19.34	8.00	36.00

*: Number in colums followed by the same letter are not significantly different at $p \leq 0.05$ (Duncan test)

southern sections of the trees. The differences between the means of the egg number according to the direction were found statistically significant in both years, except the golden variety (2001 Stark Crimson, $F = 12.598$, $df = 3,32$, $p = 0.0001$; Golden $F = 2.00$, $df = 3,32$, $p = 0.134$; Misket $F = 23.198$, $df = 3,32$, $p = 0.0001$; 2002 Stark Crimson $F = 15.135$, $df = 3,32$, $p = 0.0001$; Golden $F = 9.564$, $df = 3,32$, $p = 0.0001$; Misket $F = 14.521$, $df = 3,32$, $p = 0.0001$). Although there was no statistically significant difference between the means of the egg numbers in the case of golden variety, the pest laid most of its eggs (which is 32%) on the southern sections. Most of the deposited egg masses of ELR were found on southern quadrants of all apple varieties. Eastern parts have the second rate of egg masses and the lowest number on North and West parts of trees (Table 1).

The numbers of the egg masses laid by the ELR on Stark Crimson and Golden were not found different while there was not such a difference in case of Golden (2001 $F = 4.728$, $df = 2,24$, $p = 0.19$; 2002, $F = 17.811$, $df = 2,24$, $p = 0.0001$) (Table 2). The lowest number of eggs was laid on Misket variety.

In line with the results of this study, Nizamlioglu (1965) reported that the pest lays its eggs in masses which include eggs between 1-100 and that the mean number of the eggs in a mass is 50 while Ali Niazee (1977) stated that egg masses of ELR are 4.7 in length and 3.3 mm in width and that the number of the eggs in a mass varies between 1-3 and 120.

In their studies conducted on the preferences of the pest in respect to the plant section, Gibson (1924) reported that ELR prefers the trunk and the thick branches to lay its eggs and Nizamlioglu (1965) reported that the pest lays its eggs especially on the trunk and thick trees. Ali Niazee (1977) detected that ELR lays 90% of its eggs on the trunk and the thick trees while it lays only 10% of its eggs on the secondary branches and also it does not lay any egg on the branches with a diameter of 1 cm or lower. Ellenberger and Cameron (1977) examined the distribution of *Archips semiferanus*' (Walker) (Lep.;Tortricidae) egg masses in 2 different hosts (*Quercus rubra*, *Q. coccinea*) and found out that the pest laid 67-80% of its eggs on the southern sections of the thick middle branches. In addition, they reported that the distribution and the number of the egg masses on the tree vary depending on the population density and that the number of the eggs decreases towards the branch tips.

Ulu (1983) stated that the tree sections preferred by the pest to lay its eggs are especially the flat, smooth and ground-facing points on the skin of the thick and thin branches. The researcher reported that 26.9% of the egg masses were laid on the trunk while the rest were laid on the canopy. The results obtained from other studies conducted in various countries and in different hosts support the results of this study.

Ulu (1983) detected that 42% of the eggs laid on the canopy were on the eastern part of the tree, 24.6% of the eggs were laid on the southern part of the tree; 17.3%

were laid on the northern part and 16.1% were laid on the western part of the tree. In a study conducted on the *A. semiferanus* egg masses, Mumma and Zettle (1977) reported that 35-50% of all eggs laid were on the parts facing north- south. The results obtained by Ulu (1983) are in line with those of this study. However the findings of Mumma and Zettle (1977) are not in line with those of this study. The reason is believed to lie in that the types of two studies and the climates prevailing in the place where the studies were conducted are different from each other.

Ali Niazee (1983) affirmed that the target period in the fight against ELR should be 1st period (stages) larva which has just come out of the egg (owerwintering). An application of fight on the egg period or the 1st period larva of ELR should cover all of the parts that are up to at least 160 cm from the ground, considering the results of this study. In addition, a more meticulous application should be employed on the southern directions where approximately 50% of the eggs are laid here. In a search made in the literature, it was found out that *Bacillus thuringiensis* applications can be used in the fight given against the pest (Progar, 2000). The environmental harm to be imposed by such a pesticide disinfection which will be performed just before bud blooming would be at a minimum level as there will not be any living thing around, including parasitoids and the foreign and flowery vegetation that constitute a food source for the parasitoids.

In addition, in a survey study to be performed on ELR in the reproduction period, it is necessary to count the trees from ground up to at least 160 cm and to count include the main and the secondary branches into this section, considering the results of this study. In addition, a survey study which will be performed as the number of egg masses is statistically different in terms of directions, the survey should include four different directions of the tree.

Most important egg parasitoid of *A. rosanus* is *Trichogramma* sp. (Hym.; Trichogrammatide) (Dolphin *et al*., 1972; Öncuer and Uzun, 1991; Bulut and Kılıncer, 1993). In a parasitoid release study on the egg masses of ELR, the distribution of the egg masses over the tree should be taken into consideration. Accordingly, performance of release especially on the main branches and secondary branches at the height of 80-160 cm is thought to increase the chance of success.

REFERENCES

Ali Niazee, M.T., 1977. Bionomics and life history of a filbert leafroller, *Archips rosanus* (Lepidoptera: Tortricidae). Ann. Entomol. Soc. Am., 70: 391-401.

Ali Niazee, M.T., 1983. Pest status of filbert (hazelnuts) insects: A 10 year study. Can. Entomol., 115: 1155-1162.

Baggiolini, M., 1956. Contribution a l'etude d'une lutte rationelle contre la tordeuse *Cacoecia rosana* L. Rev. Rom. Agric., 12: 21-24.

Bradley, J.D., G.W. Tremevan and A. Smith, 1973. British Tortricoid Moths: Cochylidae and Tortricidae: Tortricinae. The Ray Society Instituted, London, Vol. 147.

Bulut, H. and N. Kılınçer, 1993. Ankara ilinde yaprakbüken türleri (*Archips* sp. Lep: Tortricidae)'nin yumurta parazitoidi *Trichogramma dendrolimi* Matsumura (Hym.:Trichogrammatidae)'nin yaşayışı ve dogal etkinligi üzerine araştırmalar. Bitki Koruma Bülteni, (In Turkish, only abstract in English), 30: 45-69.

Doganlar, M., 1987. Erzurum ve çevresindeki elma ve armut ağaçlarında bulunan yaprak bükenler ve benzer şekilde beslenen diğer Lepidopter'ler ile bunların parazitleri üzerinde araştırmalar. Turk. J. Agric. For. (In Turkish, only abstract in English), 11: 86-93.

Doganlar, O., 2003. Determination of biology and parasitoids of European leaf roller, *Archips rosanus* (Lep.: Tortricidae) on apple in Pozanti district. Ph.D Thesis, Institute of Natural and Applied Science, University of Cukurova.

Dolphin, E.R., M.L. Cleveland, E. Mouzint and R.K. Morrison, 1972. Releases of *Trichogramma minitum* and *T. cacoeciae* in an apple orchard and effects on populations of Codling Moths. Environ. Entomol., 1: 481-484.

Ellenberger, S.J. and E.A. Cameron, 1977. The spatial distribution of oak leafroller egg masses on primary host trees. Environ. Entomol., 6: 101-106.

Gibson, L., 1924. The occurrence of the Tortricid, *Cacoecia rosana* L., in Canada. J. Econ. Entomol., 17: 51-54.

Grichanov, I.Y., O.N. Bukzeyeva and K.V. Zakonnikova, 1994. The influence of temperature on the phenology of the tortricid moth *Archips rosana* L. (Lepidoptera: Tortricidae). Arch. Phytopath. Pflschutz., 29: 185-189.

Kapidani, A. and N. Duraj, 1991. Investigations on the biology and control of the tortricid *Archips rosana* L. in Albania. Pflanzenschutzberichte, 52: 79-88.

Markelova, W.P., 1957. Die blattwickler *Exapate congelatella* Cl. Und *Archips rosana* L. Als beerenobstschadlinge im Leningrader Gebiet. Revue Entomologie de URSS, 2: 355-369

Mayer, D.F. and B.P. Beirne, 1974. Aspect of the ecology of apple leaf rollers (Lepidoptera:Tortricidae) in the Okagan Walley, British Columbia. Can. Entomol., 106: 349-352.

Moreas, T. and M.G. Netti, 1996. Bioethnological observations on *Archips rosanus* L. (Lepidoptera: Tortricidae) on cherry in Apulia (Southern Italy) and possibilities for its integrated control. In IOBC/WPRS Working Group Meeting Integrated Plant Protection in Stone Fruit 24-26 September, Zaragoza (Spain), pp: 93-99.

Mumma, O.R. and A.S. Zettle, 1977. Observations on immature oak leafroller, *Archips semiferanus*. Ann. Entomol. Soc. Am., 70: 641-646.

Nizamlioglu, K., 1965. Meyve Agacı Zararlıları. Bölüm 2. Türkiye Ziraatında Zararlı Olan Böcekler ve Mücadelesi Dergisi 2. Fasikül, pp: 184.

Öncuer, C. and S. Uzun, 1991. Investigations on the possible usefulness of *Trichogramma cacaeciae* Marchal (Hymenoptera: Trichogrammatidae) for the biological control against *Archips* sp. (Lepidoptera: Tortricidae) which are harmful on cherry trees in Izmir and Manisa Provinces. Turk. J. Agric. For., 15: 432-444.

Pluciennik, Z. and U. Tworkowska, 2004. Remarks on the biology of the filbert leafroller (*Archips rosanus* L.) in climatic conditions of poland. J. Fruit Ornam. Plant Res., 12: 97-104.

Progar, R.A., 2000. Efficacy of MVPII Bt and spinosad for control of filbert leafroller on hazelnuts Proc. WOPDMC, 74: 39-41.

Staudinger, O. and H. Rebel, 1901. Catalog der Lepidopteren des Palearctischenn Faunnengebietes. Berlin, pp: 368.

Ulu, O., 1983. Izmir ve Manisa illeri çevresi taş çekirdekli meyve ağaçlarında zarar yapan *Archips* (=*Cacoecia* spp. (Lepidoptera: Tortricidae)) türleri, tanımları, konukçuları, yayılışları ve kısa biyolojileri üzerinde araştırmalar. T.C. Tarım ve Orman Bakanlığı Zirai Mücadele ve Zirai Karantina Genel Müdürlüğü Bornova Bölge Zirai Mücadele Araştırma Enstitüsü Müdürlüğü Araştırma Eserleri Serisi (In Turkish, only abstract in English), 45: 165.

Yıldırım, N., 1957. Nigde meyve agaçlarında zarar yapan *Cacoecia rosana* L.'nin arız olduğu bitkiler, kısa biyolojisi ve mücadelesi üzerine arastırmalar. Ziraat Vekaleti. Ankara Zirai Mücadele Enstitüsü Müdürlügü (In Turkish, only abstract in English), 12: 67.