Research article

Surmeli, M. and N. Demirel, Controlling with Mass Trapping and Determination of Damage Rates of Cydia pomonella L. (Lepidoptera: Tortricidae) at Good Agricultural Practices of Walnut Orchards. 2022, 5(3): p. 519-525. DOI: 10.38001/ijlsb.1124392

Controlling with Mass Trapping and Determination of Damage Rates of *Cydia pomonella* L. (Lepidoptera: Tortricidae) at Good Agricultural Practices of Walnut Orchards

Mustafa Sürmeli[1], Nihat Demirel[1]*

ABSTRACT

The current study was carried out in 2018-2019 at good agricultural practices of walnut orchards to control mass-trapping and determination of damage rates of codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) in Hatay province of Turkey. The study was conducted at 312.43 decares good agricultural practices of walnut orchards containing 3,928 Chandler varieties tree, located at the Kışlak village of the Yayladağ district of Hatay province. Delta traps with codling moth pheromones were used. Traps were hung 1.5 m high; pheromone capsules were replaced with new ones in every forty days. In the first year, a total of 235 codling moth adults were caught by the 50 delta traps during the sampling period. The average population density of adults caught by traps was determined to be 4.61. In the second year, a total of 70 codling moth adults were caught by the 50 delta traps during the sampling period. The average population density of adults caught by traps was determined to be 1.4. In the first year, a total of 38,400 walnut fruits were harvested and 100 walnut fruit was harmed by the codling moth larvae. Thus, the damage rates of the codling moth were estimated as 0.26 percent. In the second year, a total of 443,100 walnut fruits were harvested and 9,065 walnut fruit was harmed by the codling moth larvae. Thus, the damage rates of the codling moth were estimated as 2.04 percent.

ARTICLE HISTORY
Received
1 June 2022
Accepted
12 August 2022

KEYWORDS
Walnut,
Cydia pomonella,
pheromone,
damage rate,
Hatay

Introduction

The walnut, *Juglans regia* L., (Juglandaceae: Fagales) is one of the most significant nut trees in the world. In 2022, the worldwide production of shells was 4.498.442 tonnes, China contributed 50% (2.521.504 tonnes); other major producers were the United States (592,390 tonnes), Iran (321,074 tonnes), Turkey (225,000), and Mexico (171,368) of the world total [1]. The walnut is one of the significant nut trees in Turkey which production consisting of approximately 86.852,8 ha with a total production of 195.000 tons of fruit per annum, and Hatay province's share is 236,1 ha and 1428 tons

[1] Hatay Mustafa Kemal University, Faculty of Agriculture, Department of Plant Protection, Antakya-Hatay, Turkey.
*Corresponding author: N.Demirel, ndemirel@mku.edu.tr; Tel:+90 533 663 66 55

[2]. The codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) is the most serious pest of apple, pear, peach, plum, quince and walnut [3,4,5,6,7,8,9,10,11,12,13,14,15]. Codling moth larvae directly feed on walnut fruit. The first instar larvae feed inside of the fruit. The second and third instar larvae generally feed on the green peel of the fruit. Therefore, crop loss of up to 20-50% may occur if no management strategy is applied [12,13,16]. The compound (E, E)-8.10-dodecadien-1-ol (codlemone) of the codling moth pheromone was developed by [17]. Monitoring the adult population of codling moths is conducted by pheromone traps, mating disruption dispensers, and mass-trapping [7,14,15,18,19]. Mass-trapping of *C. pomonella* has been attempted for several years with varying degrees of success [15,19,20,21,22,23,24,25,26,27,28,29]. Previous reports have shown that trapping isolated, low-density *C. pomonella* populations are more successful than attempting to mass-trap high high-density actions [29,30]. The purpose of the current study was to evaluate controlling with mass trapping and determination of damage rates of codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) at good agricultural practices of walnut orchards in Hatay province of Turkey.

Material and Methods

The study was carried out in 2018-2019 at good agricultural practices of walnut orchards to control with mass-trapping and determination of damage rates of codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) in Hatay province of Turkey. The study was conducted at 312.43 decares good agricultural practices of walnut orchards containing 3,928 number of Chandler varieties tree, located at the Kışlak village [35°94'40"K; 36°18'78"W]of the Yayladağ district of Hatay province. The walnut orchards contain seven-year-old tree. Delta traps with codling moth pheromones (E, E)-8,10-dodecadien-1-ol (codlemone) [17] were used. Traps were hanged 1.5 m high, pheromone capsules were replaced with new ones in every forty days. A totally 50 pheromone traps were used each of the sampling year. In the first year, the pheromone traps were set up on 15 May 2018 and removed on 11 September 2018. In the second year, the pheromone traps were set up on 7 May 2019 and removed on 10 September 2019. The percentage of damage rates was calculated by dividing the number of infested walnut fruits by the total number of harvested walnut fruits. All data were analyzed by analysis of variance (ANOVA) with using the SAS software (SAS Institute Inc., [31].

Results and Discussion

Mass-trapping of *C. pomonella* was studied for two years in Hatay province of Turkey. In the first year, a total of 235 codling moth adults were caught by the 50 delta traps during the sampling period. The average population density of adults caught by traps was determined to be 4.61. In the second year, a total of 70 codling moth adults were caught by the 50 delta traps during the sampling period. The average population density of adults caught by traps was determined to be 1.4. Pheromones have been applied in different ways in the control of codling moths. Capturing and killing the codling moths with pheromones has been practiced by many researchers [32,33,34,35,36,37,38,39,40,41,42,43]. The mass-trapping of the Codling moth has been attempted for several years with varying degrees of success [20,22,23,29].

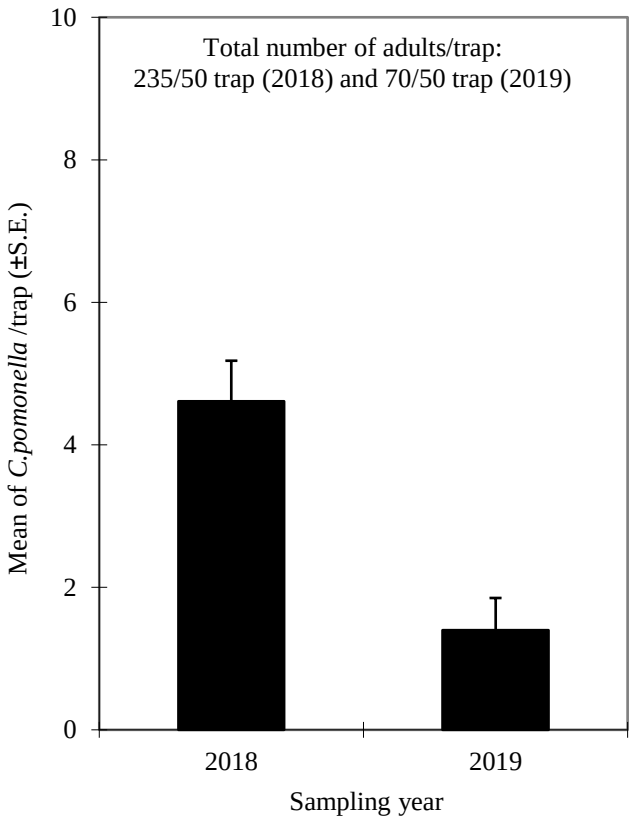

Fig 1. Population density of Codling moth on Chandler walnut orchard in 2018-2019.

The mass-trapping was used to control *C.pomonella* by many researchers [21,24,25,26,27,28,30,34,44,45]. Gilik [15] reported that the population density of codling moths on walnut was changed for the sampling times. According to the results,

the population density of codling moths was the highest in June with 35.93%, followed by July (33.12%), August (18.75%), September (6.25%), and May (5.93%) in 2016. Moreover, the population density of codling moths was the highest in May with 26.27%, followed by July (25.7%), June (20.33%), August (17.51%), and September (10.17%) in 2017.

In the first year, a total of 38,400 walnut fruits were harvested and a 100 walnut fruit was harmed by the codling moth larvae. Thus, the damage rate of the codling moth was estimated as 0.26 percent. In the second year, a total of 443,100 walnut fruits were harvested and a 9,065 walnut fruit was harmed by the codling moth larvae. Thus, the damage rates of the codling moth were estimated as 2.04 percent. Codling moth is an economically important pest on the walnut fruit (*Juglans regia* L.) in Turkey. Crop loss of 20-50% may occur, if no management strategy is applied [12-13-16]. Gilik [15] reported that the larvae of codling moths caused significant damages on walnut in Mersin. The damage rates were changed from 0,6 to 0,2 % in 2016. The damage rates were changed from 5,6 to 0,3 % in 2017.

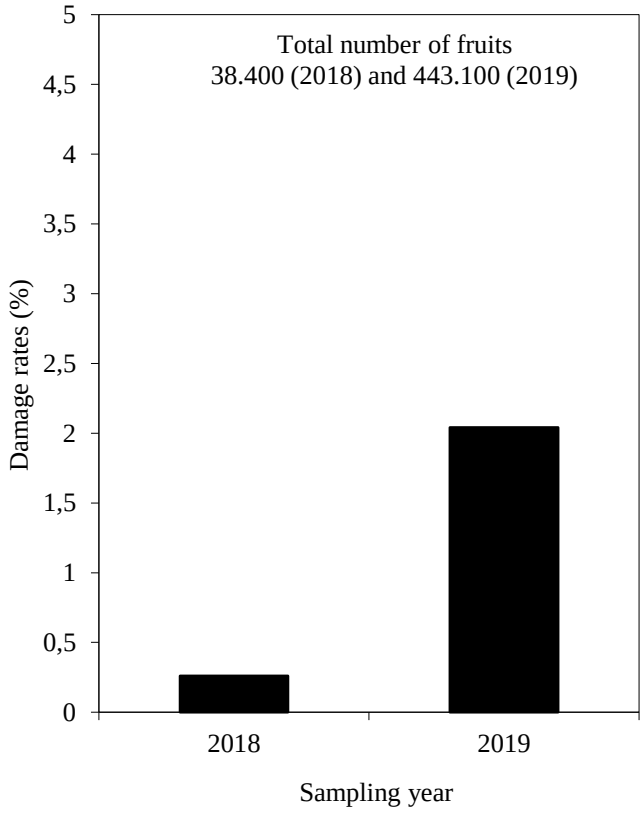

Fig 2. Damage rates of Codling moth on Chandler walnut orchard in 2018-2019

Conclusion

As a result of two years of investigation, the population density of codling moth varied each of the sampling years. In the first year, a total of 235 codling moth adults were caught by the 50 delta pheromone traps. The average population density of adults caught by traps was determined to be 4.61. In the second year, a total of 70 codling moth adults were caught by the 50 delta traps. The average population density of adults caught by traps was determined to be 1.4. In addition, the damage rates of codling larvae were changed each of the sampling years. In the first year, the damage rates of the codling moth were estimated as 0.26 percent. In the second year, the damage rates of the codling moth were estimated as 2.04 percent.

References

1. FAOSTAT, Production of walnut with shell by countries; 2019, Browse data, World. https://www.nationmaster.com/nmx/ranking/walnuts-production, Acces Date: [26.07.2019]
2. Anonymous, Bitkisel Üretim İstatistikleri, 2016, Ankara. Erişim tarihi: [29.12.2016]
3. Hoyt SC, et al., Basic biology and management components for insect IPM. In: Integrated Management of Insect Pests of Pome and Stone Fruits (Eds Croft BA & Hoyt SC), 1983, p. 93–151.
4. Barnes, M.M., Codling moth occurrence, host race formation and damage. In: van der Geest, L.P.S., Evenhuis, H.H. (Eds.), World Crop Pests, Vol. 5: Tortricid Pests. Their Biology, Natural Enemies and Control. Elsevier, Amsterdam, 1991, p. 313–327.
5. Quarles, W, Mating disruption success in codling moth IPM. IPM Practioner, 2000, 22 (5/6):1–12.
6. Van Frankenhuyzen, A. and H. Stigter, Schadliche undnutzliche Insekten und Milben an Kern- und Steinobst in mitteleuropa, Ulmer Verlag, Stuttgart (German), 2002, pp. 288.
7. Witzgall, P. et al., Codling moth management and chemical ecology. Annual Review of Entomology, 2008, 53:503–522.
8. Çevik T., Orta Anadolu Bölgesi ceviz ağaçlarında zararlı ve faydalı faunanın tespiti üzerinde araştırmalar. Bitki Koruma Bülteni, 1996, 36 (1-2):55-72.
9. Dindar İ. and O. Ecevit, *Cydia pomonella* (L.) (Lepidoptera: Tortricidaej' nin cevizdeki biyolojisi ve zararı üzerinde araştırmalar. Türkiye 3. Entomoloji Kongresi 24-28. Eylül 1996, Ankara, 692-699.
10. Ginzel, M.D., Walnut Insects: Ecology and Control, Encyclopedia of Pest Management, 2010, 1(1): 1-3.
11. Mamay M, and E. Yanık, Determination of population development and infestation rates of codling moth [*Cydia pomonella* (L.) (Lepidoptera: Tortricidae)] by using different sampling methods in Şanlıurfa province. Journal of Agricultural Science, 2013, 19:113–120.
12. Zeki, C. and A. Ozdem, Studies on the formation of prediction and warning system in the struggle of codling moth (*Cydia pomonella* L.) (Lepidoptera: Tortricidae) in walnut orchards. Plant Protection Bulletin, 2013, 53 (3):127-140.
13. Canıhoş, E., et al., Walnut. Türkiye Bilimsel ve Teknik Araştırma Kurumu (TÜBITAK) Tarım, Ormancılık ve Veterinerlik Araştırma Grubu Yayını, 2014, p. 69.
14. Demir, P. and O.B. Kovancı, Evaluation of the effectiveness of alternative methods in the fight

against Apple worm (*Cydia pomonella* L.) (Lepidoptera: Tortricidae) in walnut orchards. Plant Protection Bulletin, 2015, 55 (4):277-304.
15. Gilik, A. Mersin ili Ceviz bahçelerinde elma içkurdu, *Cydia pomonella* L. (Lepidoptera: Tortricidae)'nun yayılışı, populasyon yoğunluğu ve zarar oranının belirlenmesi. Yüksek Lisans Tezi, Hatay Mustafa Kemal Üniversitesi, 2019, p. 69.
16. Anonymous, UC IPM Pest Management Guidelines: Walnut, Codling moth, Cydia pomonella (Reviewed 7/17, updated 7/17). UC ANR Publication 3471, UC IPM Online Statewide, Statewide Integrated Pest Management Program, Agricultural and Natural Resourches University of California. www.ipm.ucanr.edu. Acces Date: [30.07. 2017]
17. Roelofs, W., et al., Sex Attractant of the Codling Moth: Characterization with Electroantennogram Technique. Science, 1971, 174 (4006): 297–299.
18. Light D., et al., Kairomone-augmented mating disruption control for codling moth in Californian walnuts and apples. IOBC WPRS Bulletin, 2005, 28 (7):341-344.
19. Sürmeli, M, Hatay ilindeki iyi tarım uygulamaları yapılan ceviz bahçelerinde elma içkurdu, *Cydia pomonella* L. (Lepidoptera: Tortricidae)'nın kitlesel tuzaklama ile kontrolü ve zarar oranının belirlenmesi. Yüksek Lisans Tezi, Hatay Mustafa Kemal Üniversitesi, 2020, p. 46.
20. Proverbs, M.D. et al., A study to suppress codling moth (Lcpidoptera: Olethrcutidae) with sex pheromone traps. The Canadian Entomologist, 1975, 107: 1265–1269.
21. Maitlen, J.C. et al., Codling moth sex pheromone: baits for mass trapping and population survey. Environmental Entomology, 1976, 5:199-202.
22. Madsen, H. F., and B.E. Cary, Codling moth (Lepidoptera: Olethreutidae) suppression by male removal with sex pheromone traps in three British Columbia orchards. The Canadian Entomologist, 1979, 111:627–630.
23. Willson, H. R., and K. Trammel, Sex Pheromone trapping for control of codling moth, oriental fruit moth, lesser appleworm, and three tortricid leafrollers in a New York apple orchard. Journal of Economical Entomology, 1980, 73:291–295.
24. Ghizdavu, I., Investigations on the control of codling moth, *Laspeyresia pomonella* L., by means of the specific sex pheromone. Bulletin Protection of Plant, 1984, 3: 7-14.
25. Pawar, A.D., and N.C. Tuhan, Codling moth (Lepidoptera: Olethreutidae) - suppression by male removal with sex pheromone traps in Ladakh, Jammu and Kashmir. Indian Journal of Entomology, 1985, 47: 226-229.
26. Gut, L.J.,et al., Mating disruption as a control for codling moth and leafrollers. Good Fruit Grower, 1992, 43:56-60.
27. Mottus, E., et al., Performance of *Cydia pomonella*, *Argyresthia conjugella*, *Plutella xylostella*, and *Archips podana* attractant dispensers in Estonia. Proceedings of the Estonian Academy of Sciences, Biology, 1996, 45:155-170.
28. Kilic, M., et al., Research on the application possibilities of mass trapping methods against codling moth [(*Cydia pomonella* L.) (Lepidoptera: Tortricidae)] in the Black Sea region. Bitki Koruma Bulteni, 1999, 39: 45-55.
29. El-Sayed, A.M., et al., Potential of "lure and kill" in long-term pest management and eradication of invasive species. Journal of Economical Entomology, 2009, 102: 815–835.
30. Hagley, E.A.C., Sex pheromones and suppression of the codling moth (Lepidoptera: Olethreutidae). The Canadian Entomologist, 1978, 110:781–783.
31. SAS Institute, User's Guide, version 6. SAS Institute, 1998, Cary, NC, USA.
32. Losel, P.M., et al., Factors affecting the field performance of an attracticide against the codling moth *Cydia pomonella*. Pest Management Science, 2002, 58:1029-1037.
33. Alma, A., et al., "Attract and kill" a new IPM method in apple orchards against *Cydia pomonella (L.)*. IOBC WPRS Bulletin, 2001, 24:139-143.
34. Angeli, G., et al., Control of *Cydia pomonella* L. in walnuts (*Juglans regia* L.) with mating disruption technique. Atti delle Giornate Fitopatologiche, 2000, 20: 361-366.

35. Angeli, G., et al., Control of *Cydia pomonella* (L.) and *Cydia molesta* (Busck) by false trail following and attract & kill techniques. Informatore Fitopatologico, 2003, 53:45-50.
36. Trematerra, P., et al., Control of codling moth, *Cydia pomonella*, with an attracticide (attract and kill) method. Informatore Fitopatologico, 1999, 49:41-44.
37. Ebbinghaus, D., et al., Appeal: efficacy and mode of action of attract and kill for codling moth control. IOBC WPRS Bulletin, 2001, 24:95-99.
38. Puciennik, Z., et al., "Attract and kill" as control method of codling moth *Cydia pomonella* (L.) in home gardens and allotments. Journa of Fruit Ornomental Plant Research, 2002, 10:173-176.
39. Charmillot, P.J., et al., Control of codling moth Cydia pomonella L. by an attract and kill technique. Revue suisse de viticulture, arboriculture, horticulture, 1998, 29:111-117.
40. Charmillot, P.J., et al., Attract and kill: a new method for control of the codling moth Cydia pomonella. Entomologia Experimentalis et Applicata, 2000, 94: 211-216.
41. Knight, A.L., Testing an attracticide hollow fibre formulation for control of codling moth, *Cydia pomonella* (Lepidoptera: Tortricidae). Journal of the Entomological Society of British Columbia, 2003, 100: 71-78.
42. Knight, A.L., et al., Modeling the impact of a sex pheromone/kairomone attracticide for management of codling moth (*Cydia pomonella*). Acta Horticulturae, 2002, 584: 215-220.
43. Krupke, C.H., et al., Field and laboratory responses of male codling moth (Lepidoptera: Tortricidae) to a pheromone-based attract-and-kill strategy. Environmental Entomology, 2002, 31:189-197.
44. Shorey, H.H., and R.G., Gerber, Use of puffers for disruption of sex pheromone communication of codling moths (Lepidoptera: Tortricidae) in walnut orchards. Environmental Entomology, 1996, 25: 1398-1400.
45. Grant, J.A., et al., BIOS approach tested for controlling walnut pests in San Joaquin valley. California Agriculture, 2003, 57:86-92.