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The First Records of Three Moths Species (Lepidoptera) in Osmaniye Province of Turkey and Notes on External and Genital Morphology of The Species

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Abstrac: This study was conducted as field and laboratory studies in Osmaniye province. Two species belonging to Noctuidae family *Helicoverpa armigera* and *Chrysodeixis chalcites* and one species belonging to Sphingidae family *Daphnis nerii* were caught with insect net, mercury vapour light trap and white screen, at different altitudes, with various vegetation in Osmaniye. In the field studies, *Helicoverpa armigera* totally 3 male and 3 female, *Chrysodeixis chalcites* totally 5 male and *Daphnis nerii* 1 male and 1 female were collected. Specimens were dissected in the laboratory and prepared genitalia and wings slides. We described the external and male-female genital morphology of *H. armigera*, *C. chalcites* and *D. nerii* in detail and also diagnostical morphological features. As a result of the study, *H. armigera*, *C. chalcites* and *D. nerii* are first record for Osmaniye.
Keywords: *Helicoverpa armigera*,*Chrysodeixis chalcites, Daphnis nerii,* Noctuidae, Sphingidae, Lepidoptera.

Osmaniye'de üç güve türünün (Lepidoptera) İlk Kaydı ve Türlerin Dış ve Genital Morfolojileri Üzerine Notlar

Özet: Bu çalışma, Osmaniye ilinde arazi ve laboratuvar çalışmaları şeklinde yürütülmüştür. Nocuidae familyasına ait *Helicoverpa armigera* (Hübner, [1808]), *Chrysodeixis chalcites* (Esper, [1789]) ve Sphingidae familyasına ait *Daphnis nerii*, Osmaniye'de değişik bitki örtüsüne sahip çeşitli yüksekliklerdeki lokalitelerden cıva buharlı ışık tuzağı ve beyaz perde ile yakalandı. *Helicoverpa armigera*'dan toplam 3 erkek, 3 dişi, *Chrysodeixis chalcites*'den toplam 5 erkek ve *Daphnis nerii*'den bir erkek ve bir dişi toplanmıştır. Örnekler laboratuvarda preparat yapımı için hazırlandı, erkek-dişi genital ve kanat preparatları yapıldı. *H. armigera, C. chalcites* ve *D. nerii*'nin dış morfolojisi ve genital organları ayrıntılı olarak tanımlandı. Sonuç olarak, *H. armigera, C. chalcites* ve *D. nerii* türleri Osmaniye ili için ilk kayıttır.
Anahtar Kelimeler: *Helicoverpa armigera*,*Chrysodeixis chalcites, Daphnis nerii,* Noctuidae, Sphingidae, Lepidoptera.

1. Introduction

The family Noctuidae is members of Noctuioidea. There are 35 thousand species this of family distributed worldwide (Atay and Kılıç, 2014); in Turkey 1242 species and in Osmaniye 27 species (Koçak and Kemal, 2018). The genus *Helicoverpa* Hardwick, 1965 (Lepidoptera: Noctuidae) includes *Helicoverpa armigera* (Hübner, [1808]) (Karsholt and Razowski, 1996). Common name of this species are African bollworm, cotton bollworm, corn earworm and old world bollworm. *H. armigera* is a highly polyphagous species. The most important crop host of which *H. armigera* is a major pest are tomato, cotton, pigeon pea, chickpea, sorghum and cowpea. Other hosts includedianthus, rosa, pelargonium, chrysanthemum, groundnut, okra, peas, field beans, soybeans, lucerne, *Phaseolus* spp., other Leguminosae, tobacco, potatoes, maize, flax a number of fruits (Prunus, Citrus), forest trees and a range of vegetable crops (Lammers and MacLeod, 2007). *H. armigera* is feding on about 200 plant species. This species is the major pest of cotton, corn and tomato in Turkey (Koçlu and Karsavuran, 2000; Konuş and Karaağaç, 2014). Like other Noctuidae species, the adults emerge after sunset and being active at night. This species may migrate over long distances, borne by winds. *H. armigera* has recently

extended its already considerable geographical range from Europe, Africa, Asis and Australasia to the New Word (Kriticos et al., 2015), South America (Queiroz-Santos et al, 2018). In Turkey, Adana, Ağrı, Amasya, Ankara, Artvin, Bitlis, Bolu, Bursa, Denizli, Erzurum, Eskişehir, Giresun, Hakkari, Hatay, Mersin, Kars, Kastamonu, Malatya, Kahramanmaraş, Mardin, Muş, Nevşehir, Niğde, Rize, Siirt, Sinop, Sivas, Trabzon, Şanlıurfa, Van, Kırıkkale, Ardahan (Koçak and Kemal, 2018), Çanakkale (Genç et al, 2017), Manisa (Koçlu and Karsavuran, 2000).

The genus *Chrysodeixis* Hübner, [1821] (Lepidoptera: Noctuidae) includes *Chrysodeixis chalcites* (Esper, [1789]) (Karsholt and Razowski, 1996). *C. chalcites* is polyphagous multivoltin species (Murillo et al, 2013), larvae of which feed on a wide variety of leaves and fruits of vegetables, fruit and ornamental plants. *C. chalcites* (Golden twin spot moth) is distributed between 45ºN and 35ºS from southern Europe, the Mediterranean, and the Middle East to Africa (Murillo et al, 2013), Saint Helena Island (Karisch et al, 2018). In Turkey, Adana, Amasya, Ankara, Antalya, Bursa, Hatay, Mersin, Kars, Kahramanmaraş, Siirt, Trabzon, Şanlıurfa (Koçak and Kemal, 2018), Mersin (Topakcı et al, 2019). *C. chalcites* is a majör pest of tomato, lucerne, alfalfa, clover, soyabean and patato (Murillo et al, 2013). In Turkey also, it damages cucumber, tomato and green pepper (Topakcı et al, 2019).

Sphingidae (Lepidoptera) species are called hawk moths or sphinx (Akkuzu et al, 2007). Hawk moths are stout bodied moths with long narrow front wings. The family Sphingidae Latreille, 1802, contains 1450 species after the adults of which are often seen feding in front of flowers. Their larvae are large and have a distinctive horn at their rear. As a group they are widely distributed across the world except in Antarctica (Katbeh-Bader, 2014). The genus *Daphnis* Hübner is known by nine species from different parts of the globe which are dark green to greenish brown with a characteristic wing pattern of paler fasciae (Kaleka et al, 2015). The family Sphingidae contains 36 species in Turkey, only two of these species in Osmaniye (Koçak and Kemal, 2018). *Daphnis nerii* (Linnaeus, 1758) (Oleander Hawkmoth) was common on oleander (Apocynaceae) in Mediterranean region (Moore and Miller, 2008). *D. nerii* is widely distributed in the world (India, Africa, Asia and Europe (Kaleka et al, 2015). In Turkey, Antalya, Aydın, Hakkari, Hatay, Mersin, İstanbul, İzmir, Konya, Kahramanmaraş, Muğla, Van (Koçak and Kemal, 2018), Çanakkale (Tiftikci and Kornoşor, 2016).

As a result of the study, *H. armigera*, *C. chalcites* and *D. nerii* are first record for Osmaniye.

2. Materials and Method

This study was conducted as field and laboratory studies in Osmaniye province.

2.1. Field Studies

Field studies were carried out in the localities of different altitudes and vegetation covers in the Osmaniye province in 2019. All the field works were done under suitable weather conditions (without precipitation and strong winds), and started early in the morning and continued until sunset in day. In addition, samples were collected between 20:^{00} and 24:^{00} hours with the help of mercury vapour light trap and white screen. Two species belonging to Noctuidae family *Helicoverpa armigera* and *Chrysodeixis chalcites* and one species belonging to Sphingidae family *Daphnis nerii* were caught at intervals with insect net, mercury vapour light trap and white screen in different localities, at different elevations, in different climatic conditions, plant cover and sutface features in Osmaniye. In the field studies, *Helicoverpa armigera* totally 3 male and 3 female, *Chrysodeixis chalcites* totally 5 male and *Daphnis nerii* 1 male and 1 female were collected.

2.2. Laboratory Studies

Before losing body water, the collected specimens were sorted according to body sizes, and were needed with a number 2 and 3 insect needles that matched the size of the custom sized boards, strain and inhibition couples were strained in laboratory work. For the drying of the stretched specimens, they were kept at room temperature for two weeks in a dark and dry place. Male and female genital organs of species were prepared for the identification of the species following morphological examinations and measurements on the male and female specimens. The needling of the moths, stretching of the wings and genital organ preparations were done accordingly the methods that defined in Atay's work (2006). The major taxonomic characters of species were described. Important morphological organs of *Helicoverpa armigera*, *Chrysodeixis chalcites* and *Daphnis nerii* were photographed and drawn. The specimens were stored at the Biology Department of Mustafa Kemal University in Hatay.

3. Results

Genus *Helicoverpa* Hardwick, 1965 (Lepidoptera: Noctuidae)

Syn: *Helicoverpa* Hardwick, 1965 (Koçak and Kemal, 2018)

***Helicoverpa armigera* (Hübner, [1808]**

Syn: *obsoleta* auct. Nec Fabr., 1775; *barbara* Fabricius, 1794 [rejected]; *armigera* Hübner, [1808]; *pulverosa* Walker, [1857]; *uniformis* Wallengren, 1860; *rama* Bhattacherjee & Gupta, 1972 (Koçak and Kemal, 2018).

Materials Examined
18.IV.2019 2♂, 1♀; 15.V.2019 1♂, 1♀; 15.VI.2019 1♀ (37°05'43" N; 36°18'39" E, 183 m; 37°04'40" N; 36°12'03" E, 175 m; 37°02'45" N; 36°17'44" E, 281 m)

Measurements
Body Length ♂: 15-16 (15,5) mm, ♀: 14-15 (14,5) mm
Wingspan ♂: 33-35 (34) mm, ♀: 30-34 (32) mm

Male (Figure 1): On the head vertex and frons grayish yellow or light brown. Antenna filiform, not sexually dimorphic; it's length about 6 mm and it's length 0,60 times longer than forewing length. Labial palpus well developed, long, very little recurved upwards. All segments of labial palpus are grayish yellow scales; approximately twice as long as head in lateral view; first (proksimal) segment shorter than second segment; third (distal) segment reduced in size compared to other two segment. Maxillary palp reduced. Eyes with brownish are very large and semioval. Haustellum is well developed and it's length approximately 6 times eye width. On the head ocelli and chaetosemata present. Head 1,53 times wider than it's height (Figure 2).
On the thorax is pale grayish yellow or light brown.
Forewings are narrow and approximately triangular-shaped, it's length 1,30 times longer than it's width. The upper surface of the forewings; dull greenish to gray or light brown; dark band is situated between external transversal and submarginal lines; transversal lines, submarginal line and reniform spot are diffused. Fringe is very short. The ventral surface of the forewings; completely with pale grayish yellow or beige; reniform spot and small spot very dark gray. Hindwings are broad and it's length 2,10 times longer than it's width. The upper surface of the hindwings; pale yellow with brown band before external edge; dark round spot is situated in the middle of wing. Fringe is short. The ventral surface of the hindwings; similar to forewing, but no reniform spot.
Female moth is similar to male, but forewings orange brown.
The male genital organ is as Figure 3.
Valva is quite long and narrow; it's length 5,6 times longer than it's width. Sacculus is wide anteriorly. Uncus is long, hook shaped, it's apical portion covered with short setae. Tegumen narrow. Gnathos linked to tegumen by a tenuous membrane, projected posteriorly towards uncus apex. Saccus small and quite roundlong. Aedeagus is very long, cylindrical and narrow, it's length 6,75 times longer than it's width; with 11 sclerotized small nail like cornitti. Bulbus ejaculatorius is well developed.
The female genital organ is as Figure 4.
Apophysis posterioris and apophysis anterioris are well developed and narrow; the anterior one slightly curved; the posterior one straight. Bursae copulatrix well developed and membranous, with 4 signa. Spermatheca long, helical, twice as long as bursae copulatrix.
Veins of forewing and hindwing are drawn (Figure 5).

Figure 1. Adult of *Helicoverpa armigera* (Noctuidae) (Male and Female)

Figure 2. The head structure of *Helicoverpa armigera*

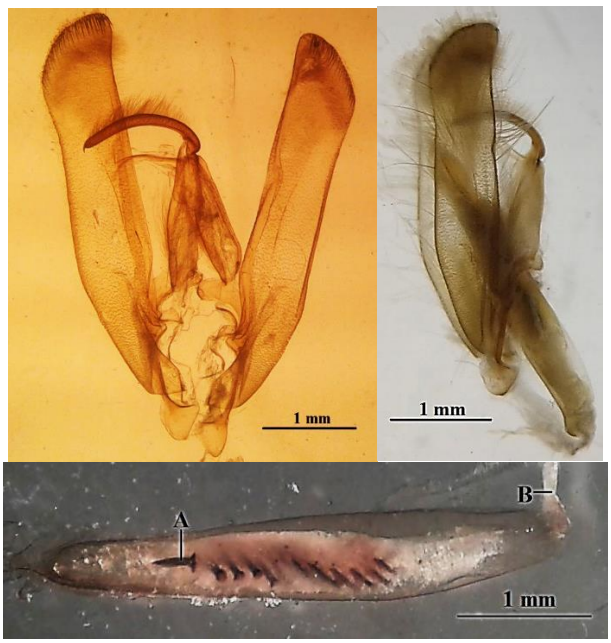

Figure 3. The Male Genitaliae of *H. armigera* (Valva and Aedeagus, A- Cornutus; B- Bulbus ejaculatorius).

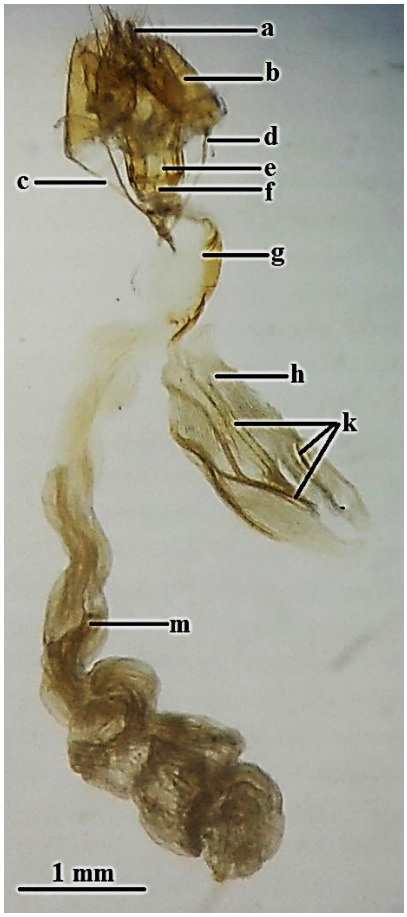

Figure 4. The Female Genitaliae of *H. armigera* (a- Papilla analis, b- Tegum VIII, c- A. anterioris, d- A. posterioris, e- Lamela postvaginalis, f- L. antivaginalis, g- Ductus bursae, h- Bursae copulatrix, k- Signa, m- Spermatheca).

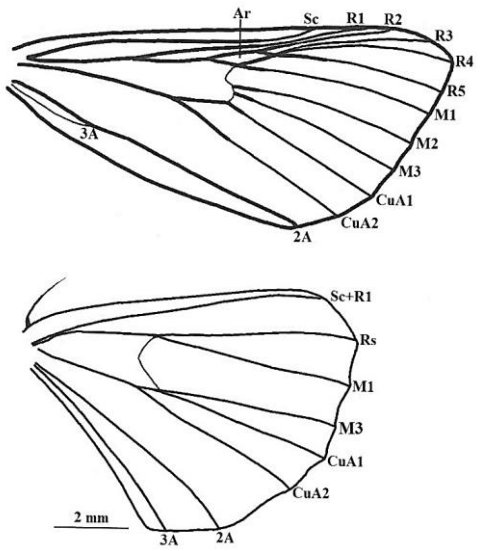

Figure 5. Veins of forewing and hindwing of *H. armigera*

Genus *Chrysodeixis* Hübner, [1821] (Lepidoptera; Noctuidae)

Syn: *Chrysodeixis* Hübner, [1821]; *Neoplusia* Okano, 1963 (Koçak and Kemal, 2018).

***Chrysodeixis chalcites* (Esper, [1789])**

Syn: *chalcites* Esper, [1789]; *chalsytis* Hübner, 1790; *bengalensis* Rossi, 1794; *quaestionis* Fabricius, 1794; *verticillata* Guenee, 1852; *integra* Walker, 1858; *adjuncta* Walker, 1865 (Koçak and Kemal, 2018).

Materials Examined

10.VI.2019 3♂; 10.VII.2019 2♂; (37°05'43" N; 36°18'39" E, 183 m; 37°04'40" N; 36°12'03" E, 175 m; 37°02'45" N; 36°17'44" E, 281 m)

Measurements

Body Length ♂: 15-16 (15,5) mm; Wingspan ♂: 33-34 (33,5) mm

Male (Figure 6): On the head vertex and frons golden brown. Antenna filiform, fuscous brown and long, it's length 0,65 times longer than forewing length. Labial palpus well developed, pale brown, recurved upwards and almost reaches to frons. All segments of labial palpus are covered with smooth scales over them. Eyes are light brownish and very large. Haustellum is well developed. On the head ocelli large, but chaetosemata absent. Head 1,75 times wider than it's height (Figure 7).

Thorax is golden brown color. There are two prominent crests on the thorax .

Forewings are wide and almost triangular-shaped, it's length 2 times longer than it's width. The upper surface of the forewings; ground color golden-orange to bronze-brown, slightly speckled with gray brown; terminal line pale brown on anterior half; with a silver or bright white stigma usually consisting of two similar oval spots. Fringe is long and pale brownish beige. The ventral surface of the forewings; completely with pale beige. Hindwings are broad and it's length 1,25 times longer than it's width. The upper surface of the hindwings are completely with pale brown-gray, darker towards margin, with dark gray veins. Fringe is short and pale tan. Abdomen is pale yellowish beige, Males with tufts of yellowish beige long scales on sides of abdomen, and black scales at apex ventrally.

The male genital organ is as Figure 8.

The genitalia are characterized by valva elongate and wider at base than towards the apex, quite long and narrow; it's length 6,55 times longer than it's width, with a tight group of setae at the apical margin. Teguman is quite broad. Uncus is long, hook shaped, its apical portion covered with short setae. Saccus is very elongate and V shaped. Aedeagus is very elongate and with a bulbous base, with several apical cornuti; basal cornutus is very elongate.

Veins of forewing and hindwing are drawn (Figure 9).

Figure 6. Adult of *Chrysodeixis chalcites*

Figure 7. The head structure of *Chrysodeixis chalcites*

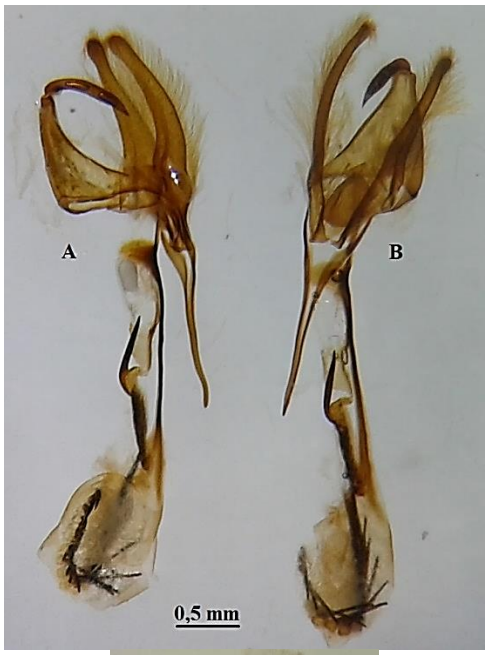

Figure 8. The Male Genitaliae of *Chrysodeixis chalcites* (General Structure and Aedeagus)

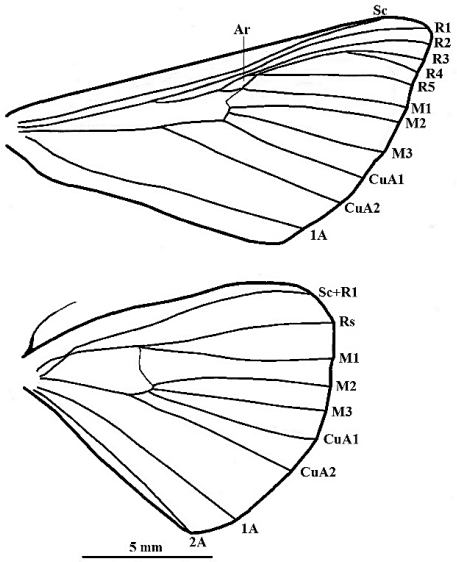

Figure 9. Veins of forewing and hindwing of *Chrysodeixis chalcites*

Genus *Daphnis* Hübner, [1819] (Lepidoptera; Sphingidae)

Syn: *Daphnis* Hübner, [1819]; *Regia* Tutt, 1903 (Koçak and Kemal, 2018).

***Daphnis nerii* (Linneaus, 1758)**, *Syst. Nat*., 10: 490; id., 1767, *Syst. Nat*., 12: 798; Cramer, 1779, *Pap. Exot*., 2: 51 (Kaleka et al, 2015).

Syn: *nerii* Linneaus, 1758; *infernelutea* Saalmüller, 1884; *confluens* Closs, 1912; *nigra* Schmidt, 1914; *bipartita* Gehlen, 1934 (Koçak and Kemal, 2018).

Materials Examined

15.VIII.2019 1♂; 25.IX.2019 1♀; (183 m; 37°04'40" N; 36°12'03" E, 175 m; 37°02'45" N; 36°17'44" E, 281 m)

Measurements

Body Length ♂: 56 mm; ♀: 60 mm

Wingspan ♂: 110 mm; ♀: 115 mm

Male (Figure 10): On the head vertex and frons green; frons broadly rounded. Antenna thick, greenish beige and not long, 15 mm; it's length 0,35 times longer than forewing length. Labial palpus well developed, upturned, smoothly scaled, grayish green, broad with basal segment slightly longer than second; the third segment is shorter about one fifth of the second segment. Eyes are dark brownish and very large. Haustellum is well developed. Head 1,15 times wider than it's height.

Thorax is green and there are darker triangular shapes in the form of a collar.

Forewings are large and long almost triangular-shaped; it's length 2,5 times longer than it's width. The upper surface of the forewings; ground color green with basal beige patch and a black spot on it; postbasal and discal areas are with light pink transverse band. The ventral surface of the forewings; completely with pale grayish green; submarginal band is very thin and white. Hindwings are small and it's length 2,5 times longer than it's width. The upper surface of the hindwings are with pale brown-gray and green; submarginal band is thin and white.

The male genital and female organs are as Figure 11, 12.
The male genitalia; uncus long, broad at base, gradually narrowing towards tip and strongly curved. Gnathos much shorter than uncus, triangular, broad at base, well sclerotized and hood like distally. Tegumen somewhat oblongate, broad, sligtly sclerotized and almost of same length of vinculum. Valva very broad, it's length 2,35 times longer than it's width; costa semi sclerotized and dense setosed. Harpe is curved sharp basal process and densely dentate dorsally. Aedeagus is narrow and long, it's length 7,70 times longer than it's width, having distal end somewhat anchor shaped thecal appendage; vesica sclerotized and without any armature.
The female genitalia; posterior apophysis long and narrow; anterior apophysis shorter than posterior apophysis. Ductus bursae large, broad, tubular with sclerotized proximal part. Corpus bursae large and balloon like with tubular shaped longitudinal signum.
Veins of forewing and hindwing are drawn (Figure 13).

Figure 10. Adult of *Daphnis nerii*

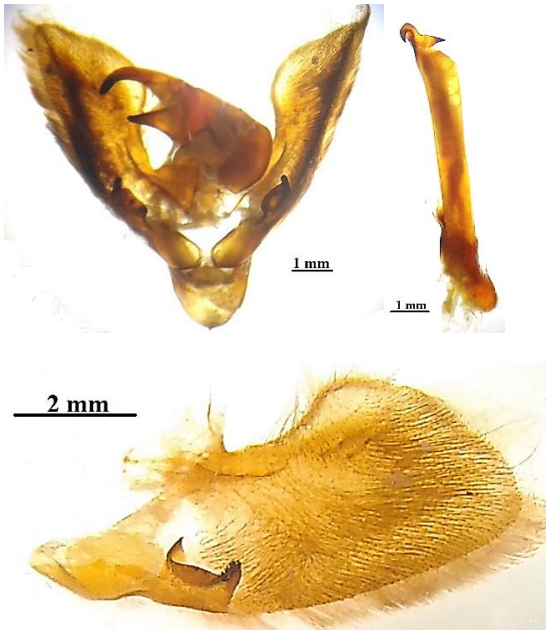

Figure 11. The Male Genitaliae of *Daphnis nerii* (General Structure, Aedeagus and Valva)

Figure 12. The Female Genitaliae of *Daphnis nerii* (General Structure)

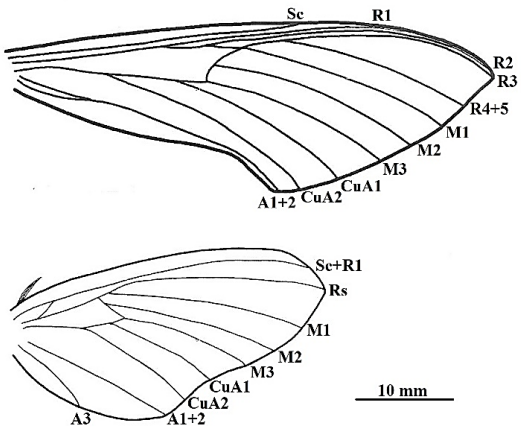

Figure 13. Veins of forewing and hindwing of *Daphnis nerii*

In this study, we described the external and the male-female genital morphology of *Helicoverpa armigera*, *Chrysodeixis chalcites* and *Daphnis nerii*. The important taxonomic characters belong to them were redescribed in detail by comparasion of different parameters with each other. Each one of the external and genital taxonomic characters were measured with digital caliper and sterio microscope.

As a result of the study, *H. armigera*, *C. chalcites* and *D. nerii* are first record for Osmaniye.

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