

Development of *Plodia interpunctella* (Lepidoptera: Pyralidae) in honey comb and its damage

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Abstract: There are numerous diseases and pests that cause damage in apiculture in Turkey, as well as in the rest of the world, and some of them cause serious damages to hives and its products. In this study, nutritional behaviours and damages caused by *Plodia interpunctella* (Hübner, [1813]), which is an important pest harmful for processed foods and warehoused products globally, in honey was studied. Larvae feeding on honey in pollen warehouses and pupas inside the honeycomb were observed. This causes a decrease in honey and beeswax quality because of their wastes and the silk webs they spun. It was detected that adult individuals growing up in honey copulated and laid eggs within a couple of days. Recently hatched larvae ate adult individuals and each other (cannibalism). Photos are added representing silky webs that larvae had spun during nutrition, wastes on honey after nutrition and behaviours related to pupa formations.

Samenvatting. Er bestaan talrijke ziekten en pestsoorten die schade veroorzaken in de apicultuur in Turkije, zowel als in de rest van de wereld, en sommige onder hen kunnen erg schadelijk zijn in bijennesten en de producten. In deze studie wordt het voedingsgedrag van *Plodia interpunctella* (Hübner, [18013]) en de schade door deze soort, die wereldwijd bekend staat als erg schadelijk in de voedingsindustrie, bestudeerd i.v.m. honing. Rupsen die zich met honing voeden in opslagplaatsen van pollen en poppen in de bijenraten werden geobserveerd. Beide veroorzaken een daling in de kwaliteit van de honing en de bijenwas door hun afvalproducten en gesponnen webben. Er werd ook geobserveerd dat de adulten in de bijenkassen copuleerden en na enkele dagen reeds eitjes afzetten. Recent uitgekomen rupsen voedden zich met adulten en met elkaar (kannibalisme). Foto's worden getoond van de webben, het afval in de raten en het gedrag tijdens het verpoppen.

Résumé. Il y a de nombreuses maladies et ravageurs qui causent des dégâts dans l'apiculture en Turquie, ainsi que dans le reste du monde, et certaines d'entre elles causent de graves dégâts aux ruches et à ses produits. Dans cette étude, les comportements nutritionnels et les dégâts causés par *Plodia interpunctella* (Hübner, [1813]), un important ravageur nuisible pour les aliments transformés et les produits stockés dans le monde entier, ont été étudiés. Des larves se nourrissant de miel dans des entrepôts de pollen et des chrysalides à l'intérieur du nid d'abeilles ont été observées. Cela provoque une diminution de la qualité du miel et de la cire d'abeille à cause de leurs déchets et des toiles de soie qu'ils filent. Il a été détecté que des individus adultes qui grandissaient dans le miel copulaient et pondaient leurs œufs en quelques jours, et les larves récemment écloses mangeaient des individus adultes et les uns des autres (cannibalisme). On y ajoute des photos représentant des toiles soyeuses que les larves ont filées pendant la nutrition, des déchets de miel après la nutrition et des comportements liés aux formations des chrysalides.

Key words: Turkey – *Plodia interpunctella* – larva – pupa – honeycomb – pest.

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Introduction

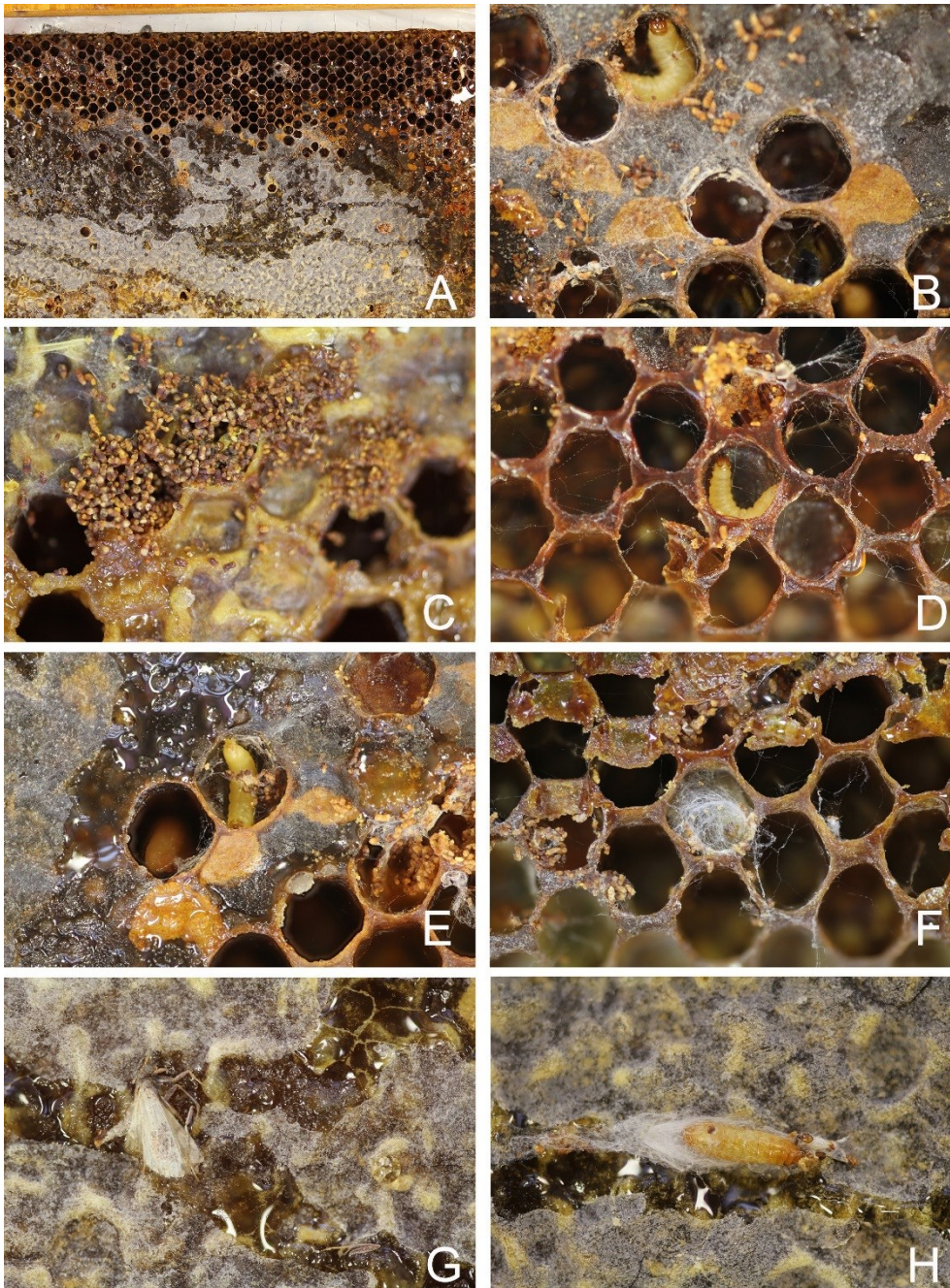
Apiculture is intensively performed in all areas of Turkey and there are nearly fifty thousand professional apiarists in our country (Aydın & Selçuk 2012). Lepidoptera are amongst the most harmful arthropods to bee hives. Some lepidopterous species known for their damages to hives are *Achroia grisella* (Fabricius, 1794), *Acherontia atropos* (Linnaeus, 1758), *Vitula edmandsii* (Packard, 1865), and *Ephestia (Anagasta) kuehniella* Zeller, 1879 (Mimioğlu 1973, Auber 1960, Bell 1981, Morse *et al.* 1990, Üstüner 2006, Sales and Marketing Group 2006). The most important pest species in apiculture, however, is the greater bee moth; *Galleria mellonella* (Linnaeus, 1758). There is a severe fight between commercial beekeeping focussing on this greater bee moth in Turkey today. Yet, other arthropods harmful to bees as well are ignored; these pests which do not harm colonies directly but cause some economical losses in general (Aydın & Selçuk 2012).

Plodia interpunctella (Hübner, [1813]) belongs to the Phycitinae subfamily of the family Pyralidae. It is a quite common house-pest which generally feeds on warehoused food products (Thomas & Marle 2015). The products or groups of products that have been reported to be infested by *P. interpunctella* are listed in several publications (e.g. Johnson *et al.* 1992, 1995; Sedlacek *et*

al. 1996, Nansen & Phillips 2003, 2004). Infestations of *P. interpunctella* can cause direct product loss and indirect economic costs through pest control costs, quality losses, and consumer complaints (Phillips *et al.* 2000). A general description of all life stages was first given by Hamlin *et al.* (1931), and there are several more recent summaries and descriptions (Rees 2004). A great number of studies was performed related to the morphology and biology of this species (Richards & Thomson 1932, Hinton 1943, Heinrich 1956). This species, also known as dried fruit pest, causes only limited damage to honey. In this study, its feeding behaviour and damage on honey was examined in Turkey.

Material and Methods

Material used in this study was a honey comb which was taken from Posof apiarists in 2015 and stored in cold storage conditions (Fig. 1A). Larvae were observed on the honey comb in February 2016 and their development has been followed. A lath was stuck into the pupa; nearly 50 pupae were picked out and put into a petri dish, and adult emergence was noted. Larvae, pupae and adults of the species were identified and pictured. Larvae in different growing stages, their feeding behaviour and silky webs, wastes on the honey after nutrition and pupae were photographed with a Canon EOS 550D camera.



Figs 1A–H. Damage caused by *Plodia interpunctella*:
 A.– honeycomb with *Plodia interpunctella*.
 B–C.– *Plodia interpunctella* larval excrements in honeycomb.
 D–E.– Larvae of *Plodia interpunctella*, and the extensive webbing that they create.
 F.– Pupa inside silken webbing.
 G–H.– Pupae and adult in honeycomb.

Results

Larvae were observed in a honey comb on 25th February 2016 and their progress was followed-up. In vitro, 12 of 50 larvae in different developmental periods entered into their pupal stage on 10th March, 25 larvae on 20–25th March and 13 larvae on 2nd April. The developmental period of pupae lasted approximately 20–25 days. Adults that emerged mated within one or two days and laid eggs.

Diagnosis of *Plodia interpunctella*

Adults have a wingspan of 17–20 mm. Head, thorax reddish brown; abdomen paler. Forewing is long and narrow; male on the underside with a fold containing a fringe of long hair; a tuft of scales at middle on costa, also present on underside. Forewings pale whitish buff at the basal area, the distal nearly two-thirds bright reddish-

brown. Wings are held above the body like a roof when resting. Hindwings are paler. Underside forewing with the distal two-thirds dark as on upper side. One third of the wings are copper colored. Young larvae are white, with a dark head. Fully grown larvae are usually yellowish white with a greenish tinge. Larvae length averages around 12–13 mm. Colour usually differs between cream and yellow and darkens depending on the size. The larva carries a long seta plaque over the 1st thoracal segment just right above its head. There are five pairs of well developed prolegs on abdominal segments 3, 4, 5, 6 & 10 that help moving considerable distances to pupate. Crochets that help to cling at the tip of abdominal segments are circular and the tips are hooked. Larvae pupate inside the cocoon weaved within an excreted silky web. Pupal length is 10 mm. The pupal case is usually yellow-brown but may be darker, depending on age. Surface is naked and the eyes are dark brown.

Damage caused by larvae of *Plodia interpunctella*

Larvae in various developmental stages use the pollen inside the combs as their nutritional source and then leave the comb. During that time, they leave their excrements and silky webs inside the comb and move into new areas (Figs 1B, 1C, 1D, 1E). They spin their cocoons using the combs they emptied and pupate inside the comb (Fig. 1F). Some larvae have been detected pupating on beeswax, between laths and comb (Fig. 1G). Mature individuals lay eggs on honey and damage the honey comb with egg wastes; then they stick on the honey and die (Fig. 1H).

Discussion

In warm climates, larvae have been reported to reproduce in pollen and cocoons or even inside dead babies' eyes and to harm combs, honey and especially pollen (Auber 1960, Morse & Nowogrodzki 1990). Damages caused by the *Plodia interpunctella* larvae with

excrements left on beeswax and honey, and with the silky webs they spin were determined during their nutritional behaviours in this study as well. Also, especially by feeding on pollen, they reduce the amount of pollen inside the comb and lower the quality of honey. They also cause damage by using dead cells to pupate. Attack is confined to the surface layers of the infested product. Some researches point out that the most effective method to fight against this species is to keep honey combs, which are desired to be stored, in a deepfreeze for some time (Auber 1960, Morse *et al.* 1990, Silacek *et al.* 1972). It is thought that the species which were examined in this study are originating from *P. interpunctella* and soiled storage products.

Boots (1998) stated that *P. interpunctella* larvae spread the infection by consuming the infected larvae. In this study, it was determined that second generation larvae exhibit cannibalistic behaviour by eating each other when other food is scarce. This practice, which was also observed in this study, supports the result that viral pathogens can be used as an effective method for fighting against the species.

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