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Spotted ash looper, *Abraxas pantaria* (L.) (Lepidoptera: Geometridae), a new ash pest in Turkey

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Abstract: *Abraxas pantaria* (L.) (Lepidoptera: Geometridae), the spotted ash looper (Light Magpie), is recognized as a new pest of common ash, *Fraxinus excelsior* (L.) in the eastern part of Turkey. Description of different developmental stages of *A. pantaria* is given. Its development, biology, damage, and parasitoids were studied in the field (Aras Valley, Karakurt, Sarıkamış, Kars Province) and partly in the laboratory during 2004-2006. In the field adults started to appear at the end of June and were seen until the middle of August. The eggs were laid mostly on the lower sides of leaves adjacent to the midrib in single layer batches. The newly hatched caterpillars fed on lower epidermis and parenchyma tissue till becoming third instar, leaving a network of veins on the upper epidermis. Then the caterpillars dispersed and started feeding on the edges of the leaves. The full grown caterpillars hanged down by means of silky threads and entered the soil to pupate. *Abraxas pantaria* had one generation per year in the ecological conditions of Karakurt, and overwintered as pupa in the soil. As the parasitoid *Cotesia callimone* (Nixon) (Braconidae) was reared from the caterpillar of *A. pantaria*. *Coelichneumon* sp. and *Cratichneumon fabricator* F. (Ichneumonidae) emerged from overwintered pupae. *Pales pavida* (Meigen) [Tachinidae] was reared from the pupae in the fall. Both braconid and ichneumonid species were reared from *A. pantaria* for the first time.

Key words: *Abraxas pantaria*, pest, biology, *Fraxinus excelsior*, *Coelichneumon* sp., *Cratichneumon fabricator*, *Pales pavida, Cotesia callimone*, parasitoid, Turkey

Abraxas pantaria (L.) (Lepidoptera: Geometridae) Türkiye için yeni bir dişbudak (*Fraxinus excelsior* (L.) zararlısı

Özet: *Abraxas pantaria* (L.) (Lepidoptera: Geometridae) ülkemizde yeni bir dişbudak zararlısı olarak belirlenmiş ve bu zararlının gelişmesi, biyolojisi, zararı ve parazitoitleri arazi koşullarında (Aras Vadisi, Karakurt, Sarıkamış, Kars) kısmen de laboratuarda 2004-2006 yıllarında çalışılmıştır. Yeni bir zararlı olması gözönüne alınarak değişik biyolojik dönemlerinin kısaca tanımları yapılmıştır. Erginler, haziran sonlarında ortaya çıkmakta ve ağustos ortalarına kadar arazide görülmektedir. Yumurtalar, çoğunlukla yaprağın alt yüzünde orta damar yakınına tek tabaka halinde toplu olarak bırakılmaktadır. Yeni çıkan tırtıllar, üçüncü tırtıl dönemine kadar alt epidermis ve parankima dokusu ile beslenmekte daha sonra dağılarak yaprak kenarlarında beslenmelerini sürdürmektedirler. Yaprakları yemek suretiyle dişbudaklarda önemli derecede zarar yapmaktadırlar. Olgun tırtıllar, bir ipek salgı yardımı ile toprağa inmekte ve toprak içerisinde pupa olmaktadır. Kışı pupa halinde geçirmekte ve yılda bir döl vermektedir. Larva parazitoiti olarak *Cotesia callimone* (Nixon) (Braconidae) elde edilmiştir. Kışlamış pupa'lardan ilkbaharda *Coelichneumon* sp. ve *Cratichneumon fabricator* F. (Ichneumonidae), sonbahardaki pupa'lardan ise *Pales pavida* (Meigen) [Tachinidae] elde edilmiştir. Belirtilen brakonid ve ichneumunid türlerinin *A. pantaria*'nın parazitoitleri olduğu ilk defa bu çalışma ile belirlenmiştir.

Anahtar sözcükler: *Abraxas pantaria*, zararlı, biyoloji, *Fraxinus excelsior*, *Cotesia callimone*, *Coelichneumon* sp., *Cratichneumon fabricator*, *Pales pavida,* parazitoit, Türkiye

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Introduction

Fraxinus excelsior (L.) (Oleaceae), known as European ash or common ash, is a species of tree native to most of Europe and southwestern Asia from northern Turkey east to the Caucasus and Alburz Mountains (Pliura and Heuertz, 2003). In Turkey common ash has been used as firewood and timber by villagers and, to a lesser extent, as ornamental plantings in the cities. However, it is used mainly for tool handles, and for sport equipment; such as hockey sticks, oars, and hurdles. Additionally, it has attracted considerable attention in pharmacology because of the contents of some biologically active substances in the leaves and bark (Pliura and Heuertz, 2003).

Abraxas pantaria (L.) (Lepidoptera: Geometridae) from Aras Valley, Karakurt, Kars Province feeding as caterpillar on the leaves of ash trees was reared in 2003. *Abraxas pantaria* is a Mediterranean species and common in Portugal and Spain (Prieto, 1986; Scoble, 1999), but it occurs in the UK and Ireland (Kimber, 2009), too. Additionally, in the collection of Siberian Zoological Museum, there are specimens collected from Armenia and Georgia (Vasilenko, 2009). *Abraxas pantaria* was treated as one of the most important pests of the ash stands in Spain (Prieto, 1986). On the other hand, it makes severe damage on ash trees in northern Caucasia (Kulikovskii and Cherkasov, 1981). Kosenko and Anferov (1996) emphasized that it has been found in increasing number in the Stavropoulos region of South-East Russia. Liović and Pernek (2000) noted *A. pantaria* as a pest of ash trees in Croatia, too.

Adults of *A. pantaria* have previously been collected from Turkey (Culot, 1987), but there has been no report of this species as an ash tree pest in this country.

In the present study *A. pantaria* was recorded from Aras Valley (Erzurum and Kars provinces) as a defoliator of *Fraxinus excelsior* stands. *Fraxinus excelsior* trees occur sporadically on the northern slopes of Aras Valley, particularly in humid locations.

The purpose of this study was to investigate the biology, damage, and natural parasitoids of this new pest in the ecological conditions of Karakurt, Kars. Furthermore, considering the fact that *A. pantaria* is a new pest for Turkey; the developmental stages are shortly described.

Material and methods

Present study was conducted during 2004-2006 (some more observations related to parasitoids were carried out in the summer of 2007 and 2008) both in field and laboratory conditions. For field studies ash tree stands were chosen in the location "Şeytan Geçmez" (40°07′679N, 42°29′103E, at an altitude of 1500-1550 m) Karakurt, Sarıkamış (Kars Province), 120 km east of Erzurum, on the northern aspects of hills in Aras Valley. Observations were performed in the study area in order to research the life history and damage of *A. pantaria* from the beginning of May to the end of October, with 1- or 2-week intervals.

Laboratory studies were carried out at Atatürk University, Faculty of Agriculture, Department of Plant Protection. In the field, at first, in the summer of 2004, the caterpillars of *A. pantaria* feeding on the leaves of ash tree were collected together with shoots and leaves of tree and brought to the laboratory in cotton bags. The caterpillars were transferred to the rearing cages (30 × 30 × 50 cm) having shoots or leaves of ash tree dipped in glass tubes with water covered with cotton stopper and kept in a rearing room at 20-22 °C (Figure 1a) with natural light (the southern side of the room has a large window). Every 1 to 3 days withered leaves were renewed with fresh ones. Before the caterpillars become fully-grown, soil (5 cm) was placed to the bottom of the cages to create an environment for pupation of mature caterpillars. In the years of 2005 and 2006, the leaves having egg masses were collected randomly from the study area and brought to the laboratory in iceboxes and were placed in 90 mm Petri dishes and kept in a rearing room (20-22 °C with natural light) until hatching. To provide humidity in the Petri dishes, a small piece of wet cotton was placed in the bottom of each of the Petri dish. Eggs in Petri dishes were examined daily, allowing also checking for the presence of egg parasitoids. To obtain larval parasitoids, the caterpillars were collected in the field twice with 10 days intervals in August and inserted in 3 different desiccators with top having a hole covered with gauze to provide ventilation, 50 caterpillars each (Figure 1b). They were kept in the rearing room. Additionally, to obtain larval-pupal or pupal parasitoids, the pupae of *A. pantaria* were collected every October in the field under trees by digging the soil, and were brought to

Figure 1. a) Leaf of ash dipped in glass tube, b) Desiccators to raise larvae.

the laboratory together with soil in plastic containers and kept in the refrigerator (at about minus 5-10 °C) for about 4 months for supplying cold requirement. In March they were transferred to cages (30 × 30 × 50 cm) and kept at room temperature (20-22 °C with natural light). With several-day intervals, the cages were examined and emerging parasitoids were removed and killed in a killing jar filled with ethyl acetate.

Fifteen caterpillars of each instar were measured for body length and head capsule dimensions; 5 pupae and 5 adults were used for the body measurements, and 15 eggs were used for egg measurement. All the measurements were carried out with an ocular micrometer using a binocular stereo microscope (Carl Leitz).

Results

Description of the developmental stages

Adults: *Abraxas pantaria* adults (Figure 2a) are white to creamy (bone color); head, thorax, and abdomen with light brown hairs; thorax and each abdominal segments have dark brown spots; eyes is blackish brown; antennae are filiform and without hairs in females; the length of antennal segments almost twice of width; in the males more or less filiform with white hairs; tegulae with long yellowish airs; wings are white, base of wings darker, almost the same color of thorax, fore wings with light brown spots toward the apical margin very close to the middle; these spots form an irregular band; hind wings have smaller spots; the spots both on fore and hid wings show variations; in some specimens they are very light, almost absent. When the butterfly is in a resting position with wings spread, head, thorax, abdomen, and the base of the wings are almost of the same color (light brown with dark spots) (Figure 2a). Wing spread measure 38-42 mm in the female and 35-40 mm in the male; the legs are of yellowish color with brown spots.

Eggs: Eggs of *A. pantaria* (Figure 2b) are greenish white in pearl brightness when first deposited, later they become dull; ovoid formed with reticulated shell, a little squashed laterally; their size is 0.7 × 0.5 × 0.4 mm.

Caterpillar: The caterpillar stage of *A. pantaria* (Figures 2c and 2d) has 5 larval instars. The emerging caterpillar, first instar, is of dull color, yellowish brown, prothoraxic shield light brown, abdominal segments with almost unclear small light spots dorsally, measures 2.4-2.5 mm in length, and cephalic capsule has a width of 0.3-0.4 mm; the second instar larva is light brown or almost brown with distinct spots dorsally and forming little noticeable lines, body length 3.0-3.5 mm, cephalic capsule 0.6-0.7 mm; the third instar larva has almost distinct longitudinal lines, body length 5.0-6.5 mm, and cephalic capsule 9.5-1.2 mm; the fourth instar larva is greenish with well-defined longitudinal lines, body length is of 10-14 mm, the cephalic capsule 1.3-1.4 mm; the fifth instar larva has series of dark green or naphtha colored lines on the yellowish bottom with 2 lateral white stripes, body length 23-26 mm, cephalic capsule

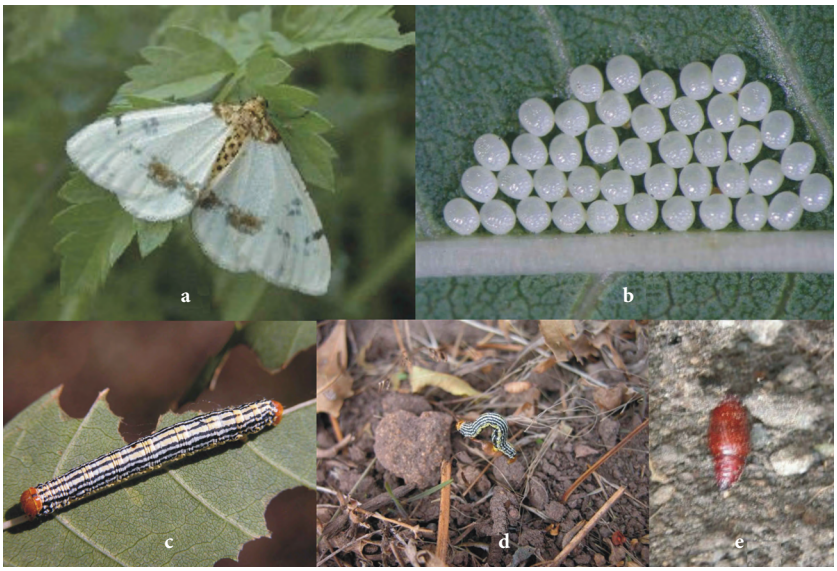

Figure 2. a) Adult, b) Egg mass, c and d) Caterpillars, e) Pupa.

1.8-2.0 mm. The full grown larva has 11 lines of variable width and boundary; the prothoraxic shields, the head, the thoraxic legs, and the external part of abdominal legs are orange; the 5 blackish ocelli on each side of the head form a semicircle.

Pupa: New formed pupa is of yellowish color, darkening to chestnut or dark reddish brown (Figure 2e); 9.0-13.0 mm in length, its width is about 4 mm.

Life circle

Laboratory studies

In laboratory conditions from overwintered pupae first emerging adults appeared on June 9, 2004, June 27, 2005, and June 12, 2006 and continued about 3 weeks in all 3 years. The period of post-metabolic sexual maturation was quite short; 3-6 days after emerging mating occurred and lasted more than 1 h. Several hours (2-4 hours) after mating, egg deposition started. First egg deposition occurred on June 12, 2004, July 2, 2005, and May 22, 2006 and it took about 2 weeks. The eggs were laid on the lower sides of leaves adjacent to the midrib in single layer batches (Figure 2b). The number of eggs in an egg mass varied from 2 to 46 eggs. One female completed egg deposition in 2-5 days with 1-6 egg-masses on different leaves. The average number of eggs laid by a female during its life time of about 2 weeks was 300. After embryonic development (12-18 days) larvae started to hatch and it lasted 8-13 days. The duration of larval development was 28-33 days. Full grown caterpillars fell on the ground and pupated in the soil at the bottom of the cages.

Field studies

In the field, adults first appeared on June 29, 2004, July 11, 2005, and June 24, 2006. Adults were observed flying on various flowering plants, mostly on the flowers of *Rosa* species, in the vicinities of ash trees, for probably feeding and copulation. They were active until the middle of August. The egg laying first occurred on July 13, 2004, July 20, 2005, and July 9, 2006 and continued 20-30 days. As previously indicated, eggs were laid in single layer batches of various sizes adjacent the midrib on the lower sides of leaves. Very occasionally, irregularly deposited eggs were also observed on a few leaves. On a single leaf, 3-132 eggs were counted in 1 egg-mass. Although the number of egg masses and the number of total eggs per female were not recorded precisely in 2004-2006 in the field, in the summer of 2007, we observed that one female laid 353 eggs consisting of 3 egg masses (118, 108, and 132 eggs). Egg-hatching started in 3 years at the end of July and continued about 4-5 weeks. It is possible to see various instars of larvae, from newly hatched to full grown, at the same trees. The development of caterpillars from

hatching to pupate was completed in 40-60 days. In general, the egg stage and various instars of caterpillars overlapped; for example, during observations of unhatched egg masses on August 14, 2006, caterpillars from the newly hatched to the fifth instars were recognized at the same locality. In the observations on September 25, still there were caterpillars feeding on the leaves in various instars, about 60% of them were fourth and fifth instars. At the same time, pupae were also detected in the soil. The full grown caterpillars hanged down by means of silky threads and reached to the ground. On the ground, they searched for a proper place to enter the soil for pupation (Figure 2d). In all 3 years, most of the caterpillars entered the soil within the first 10 days of October. However, low numbers of caterpillars were observed feeding on the leaves until almost the end of October. Pupation occurred 3-6 cm in depth. At the beginning the pupae were yellowish brown and very soft, in time the integument became harden and turned to dark brown. There is only one generation a year under the ecological conditions at Aras Valley, Karakurt, Sarıkamış, Kars.

Damage

The newly hatched caterpillars feed on mostly lower epidermis and parenchyma tissue, leaving a network of veins and the upper epidermis by making furrows of variable shapes and sizes on the leaves (Figure 3a). As the caterpillars grow, the sizes of these grooves become larger. These type of feeding continued during the first 2 instars, and then caterpillars disperse and feed on the edges of the leaves. The scattering of the caterpillars occurred either by moving from one leaf to another or by suspension on silky thread and pass to the other leaf. Wind was quite helpful in the second type of dispersal. Because of the caterpillars' consuming the edges of the leaves, the damaged leaves got into irregular shape and in some instances the whole leaf lamina was eaten, leaving only the midrib (Figures 3b and 3c). Infested leaves usually dried and turned to brownish color in time (Figure 3c). Damage caused to ash trees by *A. pantaria* was very significant in the study area; a great deal of reduction of the foliage occurred, even some trees were completely defoliated. The severe damage weakened the trees and dried twigs and trees were observed (Figure 3d).

Figure 3. Damages of *Abraxas pantaria* on *Fraxinus excelsior*: a) Damages of newly hatched caterpillars, b) Damages on the edges of the leaves, c) Dead leaves due to damages of the caterpillars, d) Defoliated twigs.

Parasitoids

In the present study no parasitoid was obtained from the eggs of *A. pantaria.* As larval parasitoid *Cotesia callimone* (Nixon) (Hymenoptera: Braconidae: Microgasterinae) was reared only from one caterpillar out of 20 with 5 individuals in September 15, 2008. Three species of parasitoids were obtained from the pupae collected from the field. In 3 years, a total of 33 (first year 11, second year 9, and third year 13) pupae could be collected. *Pales pavida* (Meigen) [Diptera: Tachinidae] was reared from the pupae in November 2005 (1 individual) and 2006 (2 individuals). *Pales pavida* could be treated as larval-pupal parasitoid of *A. pantaria*. From the overwintered pupae, 2 ichneumonid species, *Coelichneumon* sp. and *Cratichneumon fabricator* F. (Hymenoptera: Ichneumonidae), emerged in May (in 2004 1 *Coelichneumon* sp. and 2 *C. fabricator*; in 2005 3 C. *fabricator*, and in 2006 2 *C. fabricator* individuals).

Discussion

The occurrence and damage of *A. pantaria* on *F. excelsior* in the eastern Anatolia of Turkey is not surprising since it has a Mediterranean distribution. Additionally, this species occurs in northern Caucasus (Kulikovskii and Cherkasov, 1981) and in the Stavropoulos region of South-East Russia (Kosenko and Anferov, 1996).

The present study revealed that *A. pantaria* is an important pest of *F. excelsior* in the Aras Valley, Karakurt, Sarıkamış, (Kars Province). Presumably, *A. pantaria* occurs on the other parts of the country where ash trees grow. Since *F. excelsior* is an important forest tree and quite common along the coastal region of Black See and North eastern part of the country, further surveys should be conducted to search the occurrence and damage of *A. pantaria* in all these locations.

The results of this contribution can be compared favorably with the study carried out by Prieto (1986) on *A. pantaria* from Spain. In the natural conditions of Karakurt, *A. pantaria* has 1 generation a year with a long hibernation period in the pupal stage. Prieto (1986) noted that there is 1 generation, but in some localities in Spain can reach 2, even 3 generations. Karakurt is probably at a higher elevation with harsher winters and a shorter growing season than the study sites in Spain. Probably the ecological conditions in some parts of Spain are much more favorable for *A. pantaria* than Karakurt. Prieto (1986) recorded 5 larval instars in her study. The present study agrees with Prieto (1986).

As parasitoid of *A. pantaria,* one larval parasitoid, *Cotesia callimone,* was reared. This species occurs in Bulgaria, former Czechoslovakia, Hungary, Finland, and Ireland (Papp, 1987), and was recently recorded from Mongolia (Papp, 2009). In Turkey *C. callimone* species was known only from European part of the country, the Thrace (İnanç, 1997); it is a new record for the Anatolian part of Turkey. It is reared from *A. pantaria* for the first time. To date, *Setina aurita* Esper and *Callimorpha dominula* (L.) (Lepidoptera: Arctiidae) have been known as the hosts of *C. callimone* (Bathon and Tirry, 2005). Yu et al. (2005) reported 3 different braconids, *Meteorus pendilus* (Muller) and *M. versicolor* (Wesmael) from former USSR, and *M. rufus* (DeGeer) from France. A tachinid, *Pales pavida,* emerged from the pupae of *A. pantaria* in the fall (September). It is a larval-pupal parasitoid. It was already known as a parasitoid of *A. pantaria* from Spain (Bathon and Tirry, 2005). *Pales pavida* is a polyphagous parasitoid; Belshaw (1993) listed 39 lepidopteran species as hosts of *P. pavida.* In the Host Catalogue for the Turkish Tachinidae (Diptera), prepared by Kara and Tschorsnig (2003), about 8 insect species, mostly Lepidoptera, were mentioned as hosts of *P. pavida*, but *A. pantaria* is not present in that list. Bathon and Tirry (2005) listed 4 more Tachinidae species from Spain; namely, *Bactromyia aurulenta* (Meigen), *Eurysthaea scutellaris* Robineau-Desvoidy, *Senometopia lena* Richter, and *Winthemia pruinosa* (Gil Collado). Ford et al. (2000) noted another tachinid, *Phryxe unicolur* (Villeneuve) from Portugal. Two ichneumonid species, *Coelichneumon* sp. and *Cratichneumon fabricator,* were reared from the overwintered pupae in the spring. These 2 species could be larval-pupal parasitoids. Both of them were obtained from *A. pantaria* for the first time. *Cratichneumon fabricator* is the dominant species, emerged from the pupa all 3 years, a total 7 individuals were obtained out of 33 pupae. It is a poliphagous parasitoid; Thompson (1957) and Aliyev (1999) listed several lepidopteran

species as hosts of *C. fabricator*, except *A. pantaria*. As parasitoids of *A. pantaria* Yu et al. (2005) mentioned 2 ichneumonids, *Cratichneumon culex* (Muller) and *Homotherus magus* (Wesmael) from Spain. Above mentioned data reveal that the parasitoids of *A. pantaria* should be investigated more detailed in Turkey.

Finally, it is worth to emphasize that eastern Anatolia with its high, diverse biota provides very rich flora and fauna. In addition to the present finding of a new forest pest, *A. pantaria,* following new pests have been recorded on various forest plants in recent years in Erzurum and Kars provinces: *Phyllonorycter apparella* (Herrich-Schaffer) (Lep.: Gracillarida) on *Populus tremula* L. (Tozlu et al., 2002), *Heterarthrus ochropoda* (Klug) (Hym.: Tenthredinidae), on *Populus* spp. (Çalmaşur and Özbek, 2004), *Nematus salicis* (L.) (Hym.: Tenthredinidae) on *Salix* spp. (Çalmaşur and Özbek, 2006), and *Cnaemidophorus rhododactyla* (Denis& Schiffermüller) (Lep. Pterophoridae) on *Rosa* spp. (Özbek, 2008). All these contributions reveal that similar investigations should be conducted on different forest plants in other parts of the East Anatolian Region of Turkey.

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