Fruit-piercing Moths in Japan

By ISOKO HATTORI

Researcher, Laboratory of Insect Identificotion and Taxonomy, Division of Entomology, Department of Plant Pathology and Entomology, National Institute of Agricultural Sciences

Species of fruit-piercing Lepidoptera

In Japan, fruit-piercing moths are known to pierce and suck the juice from ripening fruits, causing the fruits to rot and drop. They also occur in Africa, South America, throughout South-east Asia and Australia and constitute an important problem in these areas.

Well over a hundred species belonging to thirteen families of Lepidoptera have been observed flying to orchard in Japan. The number of species is as shown in Table 1.

These lepidopterous insects are divided into two groups; those of the first group, called fruit-piercing moths, have ability to pierce or bore various fruits, and those of the second, to which most of the species belong, feed only on the juice of damaged fruits. The following Table 2 shows the species of fruit-piercers belonging to Catocalinae of Noctuidae in Japan, and seventeen species with an asterisk are considered to be more important sepcies. Structure of the proboscis.

Table 1. Number of species of Lepidoptera collected in orchards

Family	Number of species
Sphingidae	3
Arctiidae	1
Agaristidae	1
Noctuidae	91
Lasiocampidae	1
Eupeterotidae	1
Thyatiridae	1
Drepanidae	1
Geometridae	8
Pyralidae	6
Tortricidae	1
Nymphalidae	3
Satyridae	2
Total	120

Structure of the probosics

The fruit-piercing moths bore the outer skin of fruits by means of the stout tip of the proboscis which has various accessories on the outer surface. The structure of the proboscis is classified into the following two types:

1. Drilling or piercing type: The proboscis has a very stout, acute tip and particular accessories adapted for drilling the fruits and this type is divided into five groups.

Group—a includes the genera *Adris*, *Othreis*

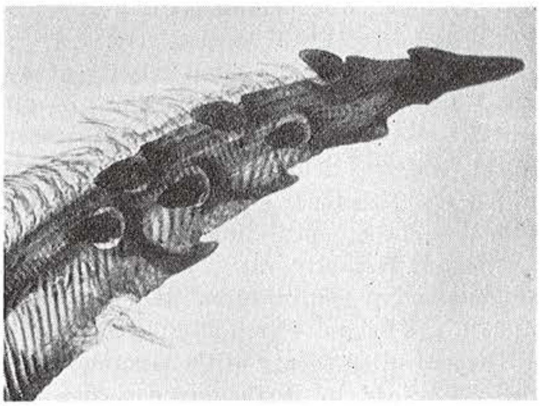


Fig. 1. The proboscis of *Adris tyrannus amurensis* Staudinger

Table 2. Fruit-piercing moths and their attacking fruits in Japan

Moths \ Attaking fruits	grape	peach	plum	apple	citrus	pear	fig	persimmon	loquat
* *Adris tyrannus amurensis* Staudinger	×	×	×	×	×	×	×	×	×
* *Othreis fullonica* Clerck	×	×		×		×			
* *Eumaenas salaminia* Cramer				×					
* *Oraesia excavata* Butler	×	×	×	×	×	×	×	×	×
* *Oraesia emarginata* Fabricius	×	×	×	×	×	×	×		×
* *Calpe gruesa* Draudt	×	×	×	×		×			×
* *Calpe lata* Butler	×	×	×	×					
* *Calpe hokkaida* Wileman	×	×	×						×
* *Calpe thalictri* Borkhausen	×	×	×	×		×	×		
* *Plusiodonta casta* Butler	×	×	×	×		×	×		×
* *Plusiodonta coelonota* Kollar		×							×
* *Serrodes campana* Guenée	×	×		×					
* *Ercheia umbrosa* Butler	×	×	×	×	×				
* *Scoliopteryx* libatrix Linné	×	×	×	×		×			
* *Anomis commoda* Butler		×	×	×					
* *Anomis flava* Fabricius	×		×		×				
* *Anomis mesogona* Walker	×	×	×	×	×	×	×		×
Parallelia stuposa Fabricius	×	×		×		×			
Parallelia arctotaenia Guenée	×	×	×	×					
Parallelia maturata Walker	×	×		×	×	×	×		
Thyas dotata Fabricius	×			×	×				×
Dermaleipa juno Dalman	×	×	×	×	×	×	×		
Speiredonia retorta Clerck	×	×	×	×	×				×
Erebus crepuscularis Linnée		×		×					×
Arcte coerulea Guené	×	×	×	×		×	×		×

and *Eumaenas*. The proboscis has two lines of several conical processes on the lateral side, serrate projections on the ventral side. An oblique edgy keel extends from the ventrolateral conical processes to the ventral projection (Fig. 1).

Group—b includes the genera *Oraesia*, *Calpe* and *Plusiodonta*. The proboscis has several conical processes and many acute spine-like projections on the lateral side.

Group—c includes the genus *Serrodes*. The proboscis is with the acute conical and spine-like projections on the lateral side, serrated projections near tip on the ventral and the dorsal sides (Fig. 2).

Group—d includes the genus *Ercheia*. The proboscis is with the acute beak-like apex. The surface is annulate.

Group—e includes the genera *Anomis* and *Scoliopteryx*. The proposcis is with spine-like

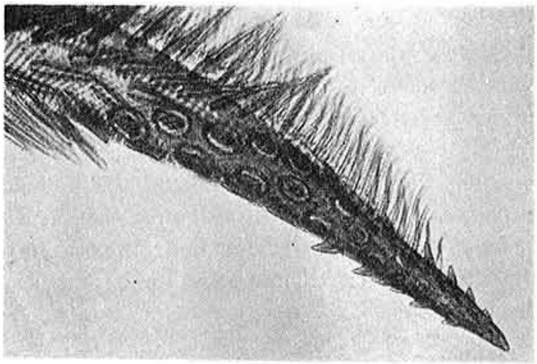


Fig. 2. The proboscis of *Serrodes campana* Guenée

projections on the lateral side.

2. Sucking type: The proboscis has a membraneous tip which is unable to pierce some fruits such as citrus fruits, apples or pears from the outer surface. Sometimes it has accessories on the lateral, ventral or dorsal sides, though they are soft (Fig. 3). Occasion-

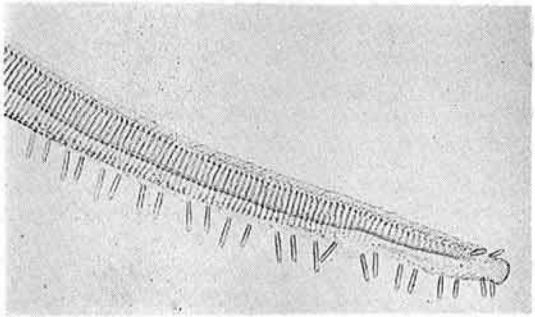


Fig. 3. The proboscis of *Enmonodia vespertilio* Fabricius

ally species belonging to the genera *Parallelia, Thyas, Dermaleipa, Speiredonia, Erebus* or *Arcte* pierce some ripened fruits such as peaches or grapes.

Habitat

Adris tyrannus amurensis Staudinger is considered the species most widely distributed throughout Japan. Both *Calpe lata* Butler and *C. gruesa* Draudt are abundant species in the northern districts and *Oraesia excavata* Butler and *O. emarginata* Fabricius are more abundant in the southern districts. *A. tyrannus amurensis* seems to be the most serious pest followed by *O. excavata* and *O. emarginata.* In some places the population density of *C. lata, C. gruesa, Ercheia umbrosa* Butler, *Dermaleipa juno* Dalman and *Arcte coerulea* Guenée seems to be higher than those of the above three species. The population density of the species such as *Serrodes campana* Guenée, *Calpe hokkaida* Wileman, *Plusiodonta coelonota* Kollar, *Othreis fullonica* Clerck, *Eumaenas salaminia* Cramer and *Anomis flava* Fabricius is low. They seem to be the local pests.

Habits

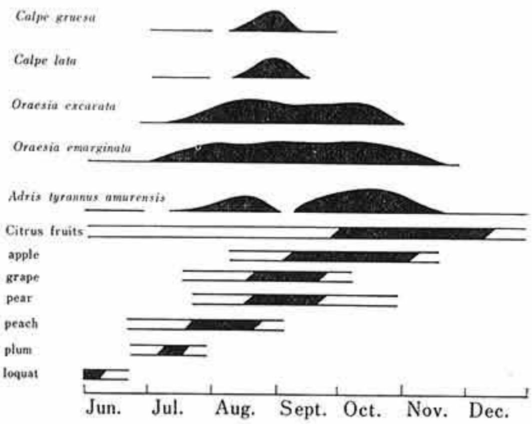
Flight habit: The appearance of fruit-piercing moths in orchards was observed about one hour after sunset and were abundant from eight to eleven at night. The distance of flight of the moths was about five hundred meters in general. It semed to be rare that the moth fully sucked juice of fruits appear twice in the same orchard.

Phototropism: The phototropic response is not equal in each species of fruit-piercing moths. *Oraesia excavata, Calpe lata, Dermaleipa juno* and *Arcte coerulea* were well attracted to blue fluorescent light traps, while *Adris tyrannus amurensis* rather showed negative phototropism. *Oraesia emarginata* was not attracted so much to lights.

Larval food-plants: Larvae of fruit-piercing moths feed on various plants such as Lardizabalaceae, Menispermaceae, Rhanunculaceae or others. The population density of larvae around orchards or in field appears very low. Larvae generally feed leaves at night and often fall to the ground when disturbed. Pupation takes place in a slight cocoon between leaves which have been drawn together with silk.

Seasonal occurrence of moths (Table 3):

Table 3. The appearance of the major pests and the harvest season of some fruit-trees.



The moths begin to appear early in June in southern districts. Because of the absence of adequate fruits to attack at the said time, they occasionally suck the juice of tomatoes or wild berries. The flying of moths to orchards generally increases from August and reaches to maximum during September and October. It coincides with the harvest season of fruits in Japan. There seems to be a tendency for *Calpe lata* and *C. gruesa* to be abundant in August and *Adris tyrannus amurenis* during August and October, and sometimes in November in southern districts. The peak of abundance of *O. excavata* extends from August to September, and the peak of abundance of *O. emarginata* from July to October.

Diagnosis

The characters of major pests are as follows:

Adris tyrannus amurensis Staudinger (Fig. 4). Length of fore wing about 50 mm.

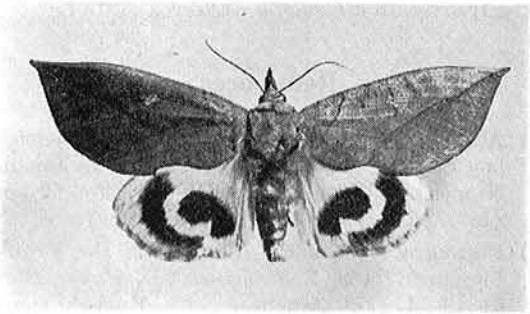


Fig. 4. *Adris tyrannus amurensis* Staudinger.

Fore wing chestnut-red in male, chestnut-green in female, with antemedial oblique rufous line; hind wing orange, with very large black lunule beyond lower angle of cell, one black submarginal band with waved edges from costa to vein 2. Habitat: Japan, Korea, Mandchuria, Amur, Ussuri.

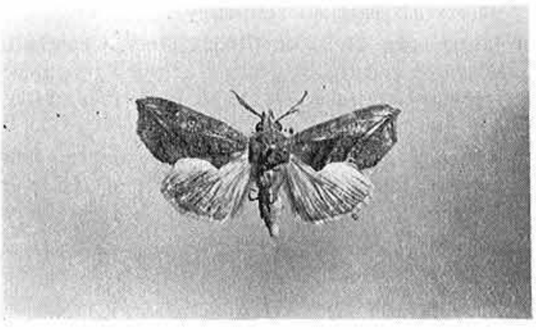


Fig. 5. *Oraesia emarginata* Fabricius.

Oraesia emarginata Fabricius (Fig. 5). Length of fore wing about 20 mm. Fore wing red-brown suffused with purplish; one dark streak on median nervure, one oblique double line from apex to inner margin beyond middle; suffused with golden brown near hind angle. Fore wing of female more variegated, one white streak on vein 2. Hind wing ochreous white suffused fuscous. Habitat: Japan (Honshu, Shikoku, Kyushu), Korea, Formosa, China, Ceylon, India.

Oraesia excavata Butler (Fig. 6). Length of

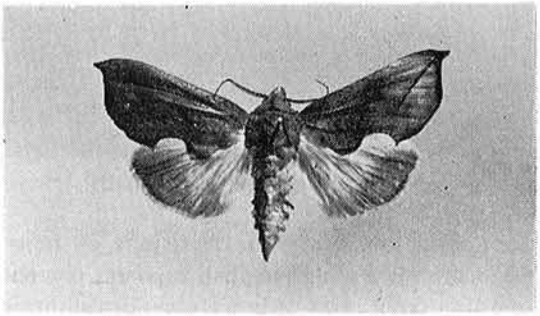


Fig. 6. *Oraesia excavata* Butler.

fore wing about 23 mm. Fore wing red-brown suffused with purplish, one dark oblique line from apex to inner margin beyond middle. Hind wing ochreous white suffused with fuscous. Habitat: Japan (Honshu, Shikoku, Kyushu), Korea, China.

Calpe lata Butler (Fig. 7). Length of fore

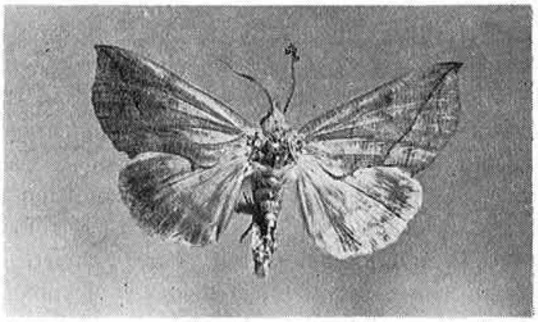


Fig. 7. *Calpe lata* Butler.

wing about 28 mm. Antennae of female filiform. Fore wing ochreous brown suffused with golden yellow; one oblique line from apex to inner margin red-brown, rather curved inner side between vein 1 and 2; with one black spot at upper and lower angle of cell. Outer margin of fore wing somewhat waved. Hind wing pale fuscous. Mid tibia of male with tuft of hair. Habitat: Japan (Honshu), Korea, Amur, China.

Calpe gruesa Draudt (Fig. 8). Length of fore wing about 28 mm. Antennae of female filiform. Fore wing purplish fulvous; one oblique line from apex to inner margin red-brown and straight; inconspicuous grey or pale olive marking on vein 3 near outer margin. Hind wing pale fuscous. Habitat: Japan (Honshu, Shikoku, Kyushu), Korea, China.

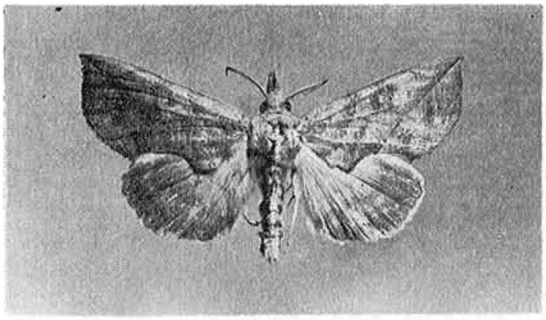


Fig. 8. *Calpe gruesa* Draudt.

Control.

As to control the pests, various treatments such as orchard illumination, fruit-covering, and others were tested in many field experiments. For the moment illuminating orchard at night is recognized as a suitable method to control many species die to the inhibition of moths to fly over and invade orchard, and pierce fruits. It must be noted that the moths' activities have relation with physiological condition of their compound eyes, namely dark or light adaptation. In the eye condition of light adaptation, which is introduced by illumination, the moths' activities are suppressed remarkably, even if under a dark environment. In the illuminated conditions, the activities of moths with light adaptation eyes are suppressed ever more remarkably.

In other experiments the influence of light elements, such as wave length, brightness, luminosity level and light energy, on the change from dark to light adaptation was examined by applying light filter methods. From these experiments both the wave length and luminosity were pointed out as important elements concerning the induction of light adaptation. It is concluded that the wave length range between blue and yellow is more effective to suppress their activities as well as higher luminosity level in general.

From comparative studies applying various lamps in peach orchards, the yellow fluorescent lamp was suitable light source against *Adris trannus amurensis* Staudinger and *Calpe* spp. On the other hand, in orange orchards the blue fluorescent lamp was more effective against *Oraesia excavata* Butler.

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