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https://doi.org/10.5109/2503

出版情報：ESAKIA. 26, pp.21-24, 1988-01-25. Entomological Laboratory, Faculty of Agriculture, Kyushu University
バージョン：
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ESAKIA, (26): 21-24, 1 pl. 1988

NOTE ON THE LIFE CYCLES OF *INUROIS KYUSHUENSIS* AND *ARICHANNA MELANARIA* (LEPIDOPTERA, GEOMETRIDAE), PESTS OF *RHODODENDRON KIUSIANUM* IN THE KUZYU MOUNTAINS*

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Abstract

Life cycles of the winter moth, Inurois ***kyushuensis*** and the Butler moth, *Arichanna melanaria fraterna* are briefly described. Both species are serious pests of ***Rhododendron kiusianum,*** one of Japan's natural monuments which grows in the Kuzyu Mountains.

Rhododendron kiusianum is one of the most famous and beautiful flowering plants in Japan. Known as Miyama-Kirishima, it grows only in the high mountains of Kyushu, one of the four main islands composing Japan. The Kuzyu Mountains are located in the center of Kyushu and are noted for their famous peaks : Daisen-zan (1,787 m), Mimata-yama (1,745), Danbaru (1,700), Hiji-dake (1,643) and others. Hiji-dake is particularly famous for its ***Rhododendron kiusianum*** because nearly the entire mountain is densely covered with this plant. In June, it displays a magnificent pink- or rose-colored "blanket" (Plate 1, Fig. A). ***Rhododendron kiusianum*** in the Kuzyu Mountains is one of Japan's natural monuments.

Chojabaru is a small town located at the foot of the Kuzyu Range and is reached by car in half a day from Fukuoka City where Kyushu University is located. Chojabaru is a base camp town for climbing Hiji-dake or the other peaks of the Kuzyu Mountains. It also takes half a day to get to the peak of Hiji-dake from Chojabaru, using a car up to 1,200 m. Thus, it is not easy to access any of the peaks of this mountain range, nor is it easy to observe insects or study the life cycles of certain species associated with ***Rhododendron kiusianum.***

It has long been reported that ***Rhododendron kiusianum*** suffered from some insect pests. Hirashima et al. (1974) first found two important pest species, ***Inurois kyushuensis*** Inoue, 1975 and *Arichanna melanaria fraterna* (Butler, 1878) after three years of painstaking study. Both species belong to the moth family Geometridae.

Inurois kyushuensis is a winter moth. The adult of this species appears in November, one of the coldest months on the top of the Kuzyu Mountains. The male is winged as usual, but the female is wingless (Plate 1, **Fig.** I). After copulation, the female deposits a batch of 15-20 eggs on the twigs of the ***Rhododendron.*** The batch of eggs is covered with blackish hairs which are taken off from the

* Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 3, No. 250).

apical portion of the female abdomen (Plate 1, Fig. F). The egg overwinters and hatches early in the following May. This season is still very cold, but food for the newborn larvae is available because the fresh young leaves of ***Rhododendron*** begin to grow at that time.

The larval period of the winter moth is about one month. Hirashima et al. (1974) reported that it passes four instars. The young larva eats the young fresh leaves first, but the full grown larva vigorously devours not only the leaves but also the buds of flowers. Thus, toward late May or early June, no green leaves and no pink flowers are left on the ***Rhododendron*** plants (Plate 1, Fig. E). It thus seems as if the entire mountain were dead. At this time, the full grown larvae of the winter moth number about 200 in a space of 50 cm^2, and this level of population is still maintained today on Danbaru, although it decreased in 1976-1979.

Pupation of the winter moth takes place in the soil just below the ***Rhododendron*** plants. The small pupa is enclosed by a thick cocoon which is hard to find in the soil or humus. The winter moth passes the long summer and autumn in the pupal stage. The life cycle of this species is shown in Fig.

It may be interesting to state here that it took Hirashima and his collaborators, Koji Yano (now Professor of Entomology, Yamaguchi University) and Michitaka Chûjô (now Associate Professor of Entomology, Kyushu University) three years to disclose the life cycle of this winter moth. Initially they did not expect at all that such an interesting moth was a pest of ***Rhododendron*** *kiusianum* in the Kuzyu Mountains. Specimens of the winter moth were sent to Dr. H. Inoue for identification, and in 1975 he gave it the name *Inurois kyushuensis.*

The second important pest species, *Arichanna* ***melanaria*** (Linnaeus, 1758) is a Palaearctic species, ranging from Europe to Japan. The Japanese population is known as the subspecies ***fraterna*** Butler, 1878, hence the common English name of this subspecies, the Butler moth. This is known as Kishita-Edashaku in Japanese.

This subspecies occurs throughout Japan. Nagano (1914) reported that *Arichanna melanaria* ***fraterna*** feeds on *Pieris* ***japonica,*** a plant belonging to the same family, Ericaceae, as ***Rhododendron.*** Curiously enough, the caterpillars of this moth do not feed on *Pieris* ***japonica*** at all in the Kuzyu Mountains, although the plant abounds there.

The Butler moth is also a univoltine species. The larva appears almost at the same time as the winter moth and eats the leaves of ***Rhododendron*** vigorously. The caterpillar population density of this moth is slightly lower than that of the winter moth. The caterpillars of the Butler moth are

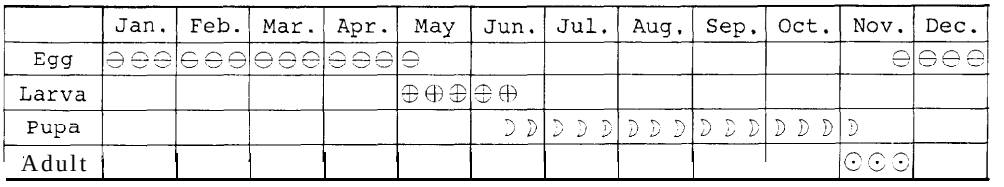

Fig. 1. Life cycle of ***Inurois*** *kyushuensis.*

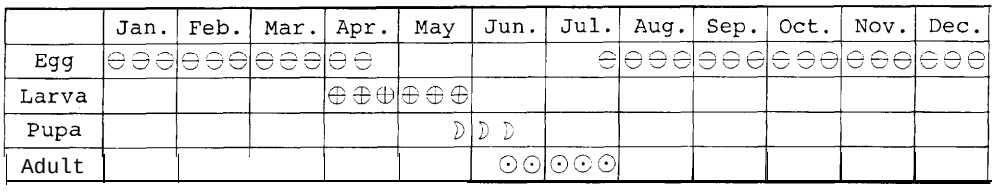

Fig. 2. Life cycle of *Arichanna* ***melanaria fraterna.***

larger and more colorful than those of the winter moth, so that one can recognize the two species at a glance. Hirashima et al. (1974) reported the color polymorphism of the ***Arichanna*** larva.

The larval period of the Butler moth is also about one month, and pupation takes place in the soil as with the winter moth. Unlike the winter moth, however, this species does not spin a cocoon. The pupa of the Butler moth is yellowish brown and shiny, and can easily be dug out of the soil.

In the Kuzyu Mountains the adult moth flies from mid June to late August. The egg passes long summer, autumn and winter. The life cycle of this species is shown in Fig, 2.

Very curiously, no eggs of the Butler moth have been found on the food plant, i. e., ***Rhododendron*** *kiusianum.* Thus, no egg has been found in the field and the oviposition site of this moth has been a puzzlement since Hirashima, Yano and Chûjô began to study its life cycle in 1971.

On November 30, 1986, the junior authors, Abe and Yoshida, went to the top of the Kuzyu Range and at last found the eggs of this species in the field. They found that the eggs were deposited one by one in the litter or dead fallen leaves of ***Rhododendron*** underneath the plants (Plate 1, Fig. J). This finding is one of the highlights in our study of the pests of ***Rhododendron*** in the Kuzyu Mountains. At the same time, Abe disclosed the first instar larva in the egg. Thus, *Arichanna* ***melanaria*** *fraterna* is understood to overwinter in the stage of the first instar larva protected by the egg chorion. The true egg period, however, is not yet known.

Dr. A. Sakanoshita of Miyazaki University (personal communication) dissected the abodomen of female and found the ovarian accessory glands are very well developed in *Inurois* ***kyushuensis*** but very poor in *Arichanna* ***melanaria.*** This fact corresponds to their ovipositing habits, Namely, the eggs are glued together and attached fast to the twigs of ***Rhododendoron*** in ***Inurois kyushuensis,*** but are scattered one by one on the leaves fallen on the ground in *Arichanna* ***melanaria.***

The control of these moths by pesticides is not recommended since ***Rhododendron*** and the caterpillars have achieved a coevolution through the years of history.

Acknowledgments

We are grateful to the Director and staff of the Aso-Kuju National Park Office, Nature Conservation Bureau, Environment Agency for their support of our study, and Prof. A. Sakanoshita of Miyazaki University for interesting information.

Reference

Hirashima, Y., K. Yano & M. T. Chûjô, 1974. Insect pests of ***Rhododendron kiusianum*** Makino (Ericaceae), with special reference to outbreaks of ***Inurois*** sp. and *Arichanna* ***melanaria*** Linnaeus (Lepidoptera, Geometridae) on Mts. Kuju and Kirishima. *Sci. Bull. Fac. Agr. Kyushu* ***Univ., 29*** *(3) : 87-115, 3* pls. (In Japanese with English summary.)

Explanation of Plate I

A: A view of Hiji-dake (1643 m) from the Bouga-tsuru camp site (1200 m). ***Rhododendron*** is in full blossom.

B: A winter view on the top of Danbaru (1700 m). All the mountain was covered with snow (December 7, 1971).

c : A view of ***Rhododendron kiusianum*** on the mountain.

D: Flowers of ***Rhododendron kiusianum.***

E: Infested ***Rhododendron kiusianum*** by the larvae of ***Inurois*** and *Arichanna* on the top of Danbaru (1700 m). The green plants remained are *Alnus firma*, "Yashabushi" in Japanese.

F: A batch of eggs of the winter moth, ***Inurois kyushuensis*** on the twig of ***Rhododendron kiusianum.***

G: A full grown larva of the winter moth and damaged leaves of ***Rhododendron.***

H: A male of the winter moth.

I: Two females (wingless) of the winter moth.

J: An egg of the Butler moth, ***Arichunna*** *melanaria*, on a dead, fallen leaf of ***Rhododendron.***

K: A first instar larva of the Butler moth taken out from the egg, and an egg chorion.

L: A full-grown larva (a black form) of the Butler moth, eating the flower bud of ***Rhododendron.***

M: The Butler moth, male (on the left, smaller) and female.

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