RES. BULL. RL. PROT. JAPAN No. 16: 35~40 (1980)

Notes on the Biology of *Dacus expandens* WALKER (Diptera: Tephritidae), with Morphological Description of the Immature Stages of *D. expandens* and *D. dorsalis*.

Fumihiko ICHINOHE, Mitsusada MIZOBUCHI and Kosei IHA

Domestic Section, Naha Plant Protection Station

Abstract: Biology of *Dacus* (*Paratridacus*) *expandens* WALKER was described in this paper. For separation of the fruit flies infesting *Garcinia subelliptica*, the immature stages of *D. expandens* were morphologically compared with those of *D. dorsalis*.

Introduction

In Okinawa or the Ryukyus, *Dacus* (*Paratridacus*) *expandens* WALKER has been known to infest the fruit of *Garcinia subelliptica* (= *G. spicata*), a beautiful evergreen tree commonly planted around houses as a protector from wind and fire. *D. expandens* is not an agricultural pest. Little has been published concerning its biology (SHIRAKI, 1933, 1954; HARDY, 1974). The host fruit, however, is one of the most representative plants (IHA, 1969; YASUDA, 1978) in the mango fly eradication program. This plant is checked to evaluate infestation levels. A mixed infestation of *D. expandens* and the mango fly, *D. dorsalis* frequently occurs in *Garcinia* fruit. Therefore, a technique is needed to clearly distinguish the two. This distinguishing technique is critical in the mango fly eradication program because of the mixed infestation. Although descriptions of the 3rd instar larva for the two species are given by EXLEY (1955) and KAWASAKI (1976), there is no available paper strictly devoted to distinguishing the two species in their immature stages.

The underlying purpose of the present study is to investigate the biological character of *D. expandens* and to comparatively describe the immature stages of the two species in question. The results are described below. Relative to the mango fly eradication program currently underway in the Nansei Islands, we hope this study will serve for checking *Garcinia* infestations.

Materials and Methods

The original stock of *D. expandens* used in this study was obtained from Nishihara Village, Okinawa in August, 1976. Additional stocks were subsequently collected from the same village at irregular intervals until termination of this study. Stock culture of *D. expandens* on the host fruit, *G. subelliptica*, was maintained at the laboratory. Rearing temperature and humidity were 27±1°C and 75% RH, respectively.

Slide preparation was as follows: The cephalic parts of the larvae were partly severed with scissors and boiled for 5 minutes in 7% caustic potash solution. The mouth hook was taken out of the cephalic part with a fine needle. It was mounted on a micro-

scope slide with a drop of Foyer's solution and covered with a cover glass. The measurements were made with an ocular micrometer under a biocular microscope.

A. General Bionomics of *Dacus expandens*

1. Adult

The adult flies of *D. expandens* appear conspicuously from the end of July to mid August when the fruit of *G. subelliptica* grows to about 3 cm in diameter. Its skin then begins to turn from green to yellow. The female flies insert their eggs beneath the skin of fruit. The larvae feed on it and grow. The fly population will increase thereafter reaching a peak in September and October, then decreasing gradually. Though rare in occurrence, *Garcinia* flowers will also bloom here and there even after October and will bear fruit until the following summer. Therefore, a minimal fly population will always exist during winter to spring.

2. Mating

First mating takes place 8 days after emergence lasting for an average of about 4 minutes. The male mates frequently. One male was observed copulating 12 times with females within the space of 8 hours.

3. Oviposition

The pre-oviposition period is 9 to 10 days. The oviposition period lasted for 2 to 3 minutes, not including the time spent futilely in attempts to insert the ovipositor. An egg mass of several eggs was usually observed in a puncture on *Garcinia* fruit. From the ovarian eggs, a single gravid female appeared capable of laying several hundred eggs in her life span.

4. Adult Longevity

A total of 206 flies (126 males and 80 females), just emerged, were reared in a $35 \times 45 \times 35$-cm cage. They were fed protein hydrolysate, sugar and water. The longevity was thus examined in the laboratory. They reached 50 cumulative percentage of survival rate of about 50 days after emergence. The longest recorded was 170 days.

5. Parasitism on *G. subelliptica*

The percentage of parasitization on dropped fruit was so high that the parasitism ranged from 22 to 78% in August for the past three years. In cases of random sampling of hanging fruit for the month, the parasitism was 14.7%. The number of parasitizing larvae per fruit ranged from 1 to 53.

6. Developmental Period of Immature Stages

The time required for incubation of egg of *D. expandens* is 4 to 6 days in 90 eggs tested and the percent hatchability was 68.9%. The larval period was 7 days in laboratory condition. Infrequently, when the larvae were unable to exit out of the *Garcinia* fruit, the larval stage was considerably prolonged. The 3rd instar larvae jumped out of the fruit in seeking pupation sites. The pupation usually occurs within 24 hours after entry of mature larvae in laboratory sand. The average pupal period was 10 days.

7. Host

Host plants so far recorded in Japan are *Cucurbita moschata* (SHIRAKI, 1933), *G.*

spicata and *Calophyllum inophyllum* (SHIRAKI, 1954). But, the fly could not be reared with *C. moschata* and, for *C. inophyllum*, any parasitism has not been confirmed for the past three years. In banana (*Musa paradisiaca*) and persimmon (*Diospyros kaki*), oviposition was observed, however, no subsequent development of larvae took place on both. For the present, only *Garcinia* seems to be the host, of the fly.

8. Overwintering

Fallen fruits of *G. subelliptica* containing the larvae in state of putrefaction, were collected during January and February. These were placed out of doors to simulate a natural climatic environment. Although some transformed into pupae, the majority in larval stage inside the fruit managed to survive up to the end of April. Live adults also, though minimal in number, were detected on leaves in winter up to spring. Even eggs were detected. This means that the *P. expandens* in all stages of existence, from larva to adult, is capable of surviving the winter period of Okinawa.

9. Distribution

The insect is distributed in Indonesia, Ceylon, India, Japan, Ryukyus, Philippines and Queensland (Hardy, 1974).

In Nansei Islands, according to our survey including personal communication (USHIO; YASUDA), the fly has been identified in the following islands:

Okinawa Prefecture; Okinawa-honto, Kume-jima, Akanashikishima, Geruma-jima, Aka-jima, Aguni-jima, Tonaki-jima, Tokashiki-jima, Minamidaito-jima, Kitadaito-jima, Miyako-jima, Ishigaki-jima and Iriomoto-jima.

Kagoshima Prefecture; Okinoerabu-jima and Yoron-jima.

B. Morphological Separation of Immature Stages of *Dacus expandens* and *D. dorsalis*

The eggs of *D. expandens* are creamy white in color, cresent in outline. The larvae are elongated, the body gradually tapering from a bluntly broad posterior end to a narrow head. The head has a pair of mouth hooks. Generally, the larvae are somewhat larger in body size than those of *D. dorsalis*. The 1st and 2nd instar larvae are creamy white, 1.23 mm long and 0.33 mm wide, 3.30 mm long and 0.57 mm wide, respectively. The mouth hook has a sclerotized tooth about midway along the ventral margin. The color of the mouth hook is light brown at the 1st instar larva, light and dark brown at both the distal and proximal half of 2nd instar larva. The 3rd instar larvae are yellowish white, 6.83 mm long and 1.05 mm wide, and, 12.31 mm long and 2.34 mm wide for the young and full-grown larvae, respectively. The color of the mouth hook disappears at ventral margin. The color of the mouth hook is dark brown, but sometimes light brown at the middle of ventral margin. The puparia are dark brown in color.

D. expandens is distinguishable from *D. dorsalis* at fullgrown 3rd instar larvae. It is relatively larger in size and the coloring of the body is more yellowish. The puparium is larger and darker in size and color, however, it is difficult to discriminate the two at younger stages.

We compared the immature stages of these species morphologically. They are characterized as described below. The descriptions were based on measurements from

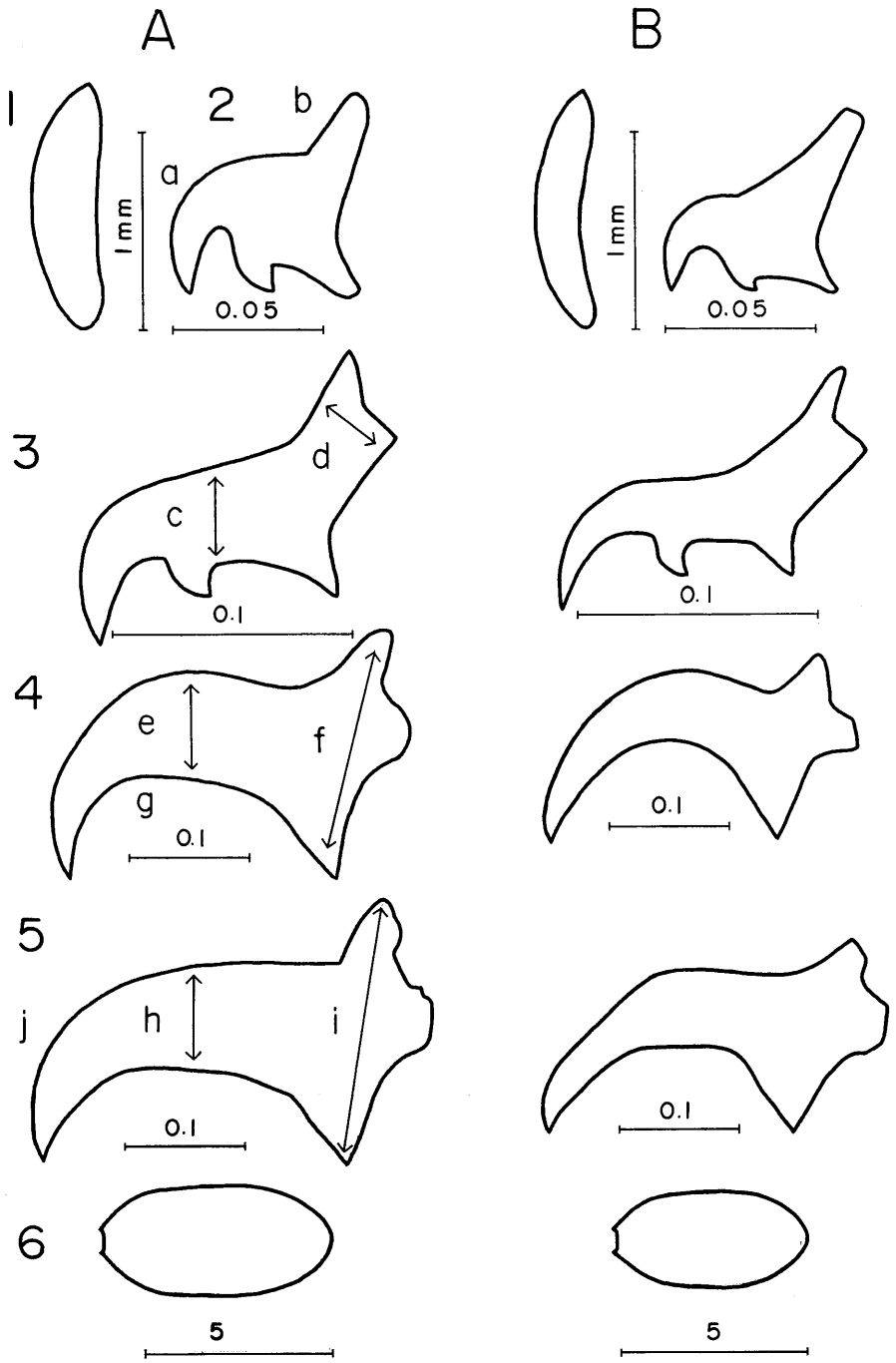

Fig. 1. A, *Dacus expandens;* B, *D. dorsalis;* 1, Egg;
2. Mouth hook of 1st instar larva; 3, 2nd instar;
4, 3rp instar of young; 5, 3rd instar of fu/l-grown;
6, Puparium.

5 eggs, 10 first, 10 second, 20 third instars and 8 puparia collected from field and laboratory investigations.

1. Egg (Fig. 1, A1, B1)
   D. expandens; Length 1.29 mm, width 0.30 mm (average).
   D. dorsalis; Length 1.20 mm, width 0.24 mm (average).
2. Larva
   1st instar larva (Fig. 1, A2, B2)
   D. expandens; Mouth hook, length 0.06 mm, width 0.07 mm, with anterior curve (a) longer than posterior straight (b) in dorsal margin. Tooth along the ventral margin is large.
   D. dorsalis; Mouth hook, length 0.06 mm, width 0.06 mm, with anterior curve and posterior straight in dorsal margin about same length. Tooth along the ventral margin is small.
   2nd instar larva (Fig. 1, A3, B3)
   D. expandens; Mouth hook, length 0.13 mm, width 0.04 mm and 0.03 mm at the middle (c) and base (d), respectively.
   D. drosalis; Mouth hook, length 0.13 mm, width 0.03 mm and 0.03 mm at the middle and base, respectively.
   3rd instar larva (Fig. 1, A4, B4)
   D. expandens; Mouth hook of young larva, length 0.31 mm, width 0.08 mm and 0.20 mm at the middle (e) and base (f), with ventral margin being straight in the middle (g). Mouth hook of full-grown larva, length 0.34 mm, width 0.10 mm and 0.20 mm at the middle (h) and base (i), respectively, with dorsal margin curving at the anterior portion (j).
   D. dorsalis; Mouth hook of young larva, length 0.28 mm, width 0.06 mm and 0.15 mm at the middle and base, respectively, with ventral margin curving in the middle. Mouth hook of full-grown larva, length 0.30 mm, width 0.07 mm and 0.17 mm at the middle and base, respectively, with dorsal margin being straight at the anterior portion.
3. Puparium (Fig. 1, A5, B5)
   D. expandens; Length 6.00 mm, width 2.63 mm (average).
   D. dorsalis; Length 5.10 mm, width 2.50 mm (average).

Acknowledgements

We wish to thank Mr. K. Koizumi, Mr. M. Sonda and Mr. T. Sugimoto of Yokohama Plant Protection Station and Mr. E.M. Kaneshima of USN Regional Medical Center, Okinawa, Japan, for their reading through the MS.

We also thank Mr. T. Obara, Director of our station for his encouragement in this work.

References

EXLEY, E.M. (1955) Comparative morphological studies of the larvae of some Queenseland Dacinae (Trypetidae: Diptera). Qd. Agric. Sci. **12**: 119–150.

HARDY, D.E. (1949) Studies in Hawaian fruit flies. Pro. Entom. Soc. Wash., **51**(5): 181–205.

———— (1974) The fruit flies of the Philippines (Diptera: Tephritidae). Pacific Insects Monograph **32**: 1–266.

IHA, K. (1969) Seasonal changes in population density of mango fly and host plants in southern Okinawa Island. J. Okinawa Agric. **8**: 44–56. (In Japanese).

KAWASAKI, R. (1976) Method of identifying larvae by process of discrimination in species of *Dacus* fruit flies in the Nansei Islands (3). Kyushu Shokubutsu Boeki, **388**: 3–6. (In Japanese).

SHIRAKI, T. (1933) A systematic study of Trypetidae in the Japanese empire. Mem. Fac. Sci. Agric., Taihoku Imp. Univ., **8**: 1–509.

———— (1954) Scientific investigations in the Ryukyu Islands. Pacific Science Board, National Research Council, Wash., **25**, D.C..

YASUDA, K. (1978) Hosts of oriental fruit fly, *Dacus dorsalis* HENDEL on Okinawa Is., Proc. Assoc. Pl. Prot. Kyushu **24**: 158–161. (In Japanese).

摘　　要

ヤエヤマミバエとミカンコミバエの卵，幼虫及び蛹の識別法

一戸　文彦・溝渕　三必・伊波　興清
那覇植物防疫事務所

ヤエヤマミバエはフクギの果実に寄生するミバエで，いわゆる農業害虫ではない。生態的研究報告は少なく，分類学的記載が若干あるのみである。しかし，フクギの果実はミカンコミバエの寄生果率が高いことから，ミカンコミバエの撲滅事業において防除効果を判定する際の代表的な寄主植物のひとつに挙げられている。また，フクギの同一果実内にヤエヤマミバエとミカンコミバエが同居していることも多々ある。そこで，1976年から始めた調査でわかったヤエヤマミバエの一般的生態の概要をまとめると共に，フクギの果実に寄生している2種のミバエの各ステージの識別点を記載した。