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The Oriental Drosophilids Breeding in Flowers

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Synopsis New records from the Oriental Region of flower breeding drosophilids, including a new species of *Drosophilella,* are given with morphological and ecological comparisons.

The flower breeding habits of drosophilid larvae have frequently been recorded for various species of the genera *Drosophila* (esp. subgenus *Phloridosa* and the *flavopilosa* species-group of subgenus *Drosophila*), *Clastopteromyia, Laccodrosophila, Scaptomyza* (esp. subgenus *Exalloscaptomyza*), *Zaprionus, Zapriothrica* and *Zygothrica.* The flowers utilized by the drosophilid larvae are also various, belonging to a number of families of both Dicotyledoneae and Monocotyledoneae. These records have, however, been obtained mostly from the Nearctic and Neotropical Regions (STURTEVANT, 1921, 1942; FROTA-PESSOA, 1952; WHEELER, 1952; HEED, CARSON and CARSON, 1960; PIPKIN, 1964; BRNCIC, 1966; PIPKIN, RODRÍGUEZ and LEÓN, 1966; WHEELER, 1970; CARSON, 1971; WHEELER, TAKADA and BRNCIC, 1962), Hawaii Islands (HARDY, 1966; HEED, 1971; KAMBYSELLIS and HEED, 1971), and the Ethiopian Region (GRABER, 1957; LACHAISE, 1974).

The informations from outside these regions have been very few. In Europe, *Gitona distigma* MEIGEN is known to breed in the flowers of *Sonchus* and *Onopordon,* but the larvae are believed to be aphidophagous (STURTEVANT, 1921, p. 55; DUDA, 1934, p. 28; WHEELER, 1952, p. 183). In Japan, *Drosophila oshimai* CHOO et NAKAMURA is found to visit flowers of *Camellia,* though the larval breeding habit is unknown (CHOO and NAKAMURA, 1973). In the Oriental Region, *Colocasiomyia cristata* DE MEIJERE and *Drosophilella colocasiae* DUDA are closely associated with the flowers of *Colocasia,* but again the larval breeding sites have not been confirmed (DE MEIJERE, 1914; DUDA, 1924 a, b).

Drosophilella colocasiae DUDA

(Figs. 1–10)

Drosophilella colocasiae DUDA, 1924 a: 226; 1924 b: 252 (Type-loc.: Nongkodjadjar, Java). —— WHEELER and TAKADA, 1964: 239. —— WHEELER, 1969: 544 (lectotype designation).

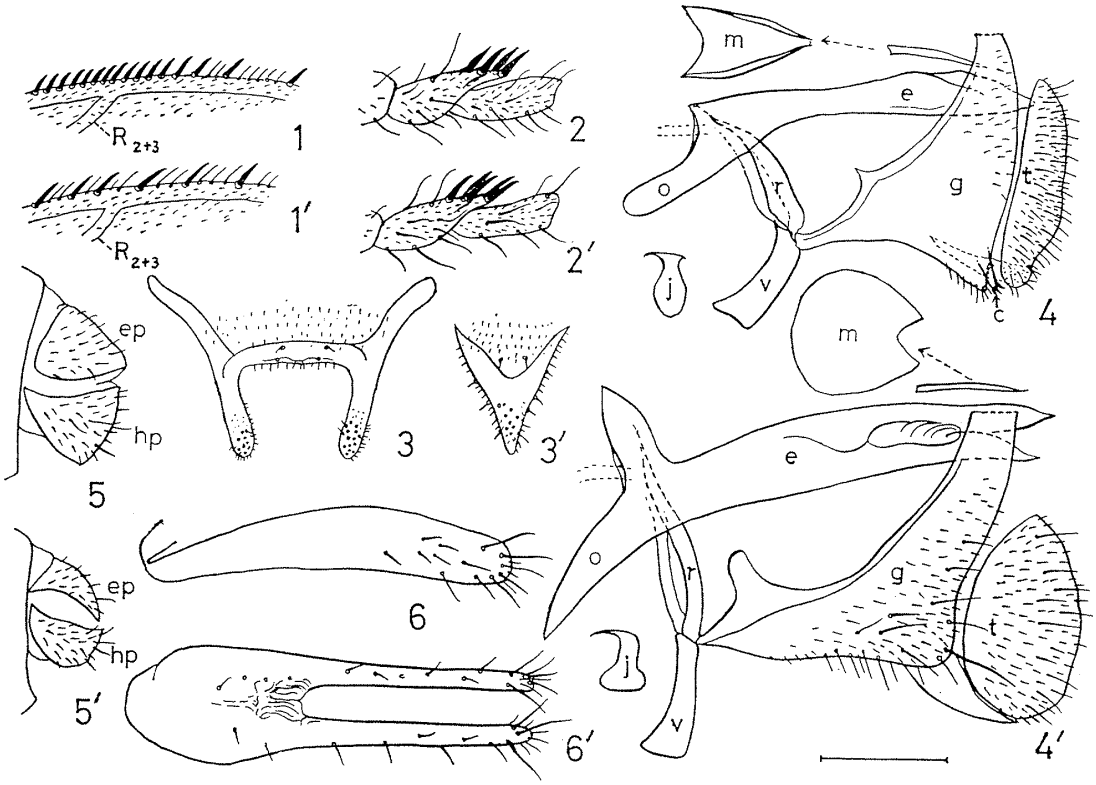
The types were collected from the flowers of *Colocasia antiquarum* (SCHOTT) at Nongkodjadjar, Java, in 1911 (JACOBSON leg.). Mr. N. WATANABE swept upon the flowers of *Alocasia* sp. and took 19 ♂, 5 ♀ at Yonehara, Ishigaki Is., Yaeyama Is., 14 June, 1973 and 44 ♂, 38 ♀ at Wulai, Taiwan, 2 August, 1974. Miss M. HONDA found many flies living within the flowers of *Alocasia odora* K. KOCH and observed

numerous larvae breeding in the decaying spadix at Shuri, in the campus of the University of the Ryukyus, Okinawa Is., 11 January, 1975. She immediately sent me a number of infested flowers, from which many flies emerged within a month.

Each of these collections from Ishigaki Is., Taiwan and Okinawa was found to involve two different species of *Drosophilella.* The identification of one of them with *D. colocasiae* was, however, fortunately not difficult due to an important discovery of WHEELER (1969) of "a cluster of four stout teeth on an elongated protuberance on the second tarsal segment of the front legs." Close examination with mounted material has revealed that this character is very stable, no exception being found among a score of samples, and that this is correlated with several other discriminative characters, as enumerated below.

1. Costa with a dense row of heavy bristles from the base of the second section up to beyond insertion of R_{2+3} (Fig. 1).

2. The protuberance of the second tarsal joint of fore leg with four teeth (Fig. 2).



Figs. 1–6. *Drosophilella colocasiae* DUDA, and, 1′–6′. *D. alocasiae* n. sp. —— 1, 1′, Wing portion around insertion of R_{2+3}; 2, 2′, male fore leg, 1st and 2nd tarsal joints; 3, 3′, male 6th abdominal sternite; 4, 4′, male genitalia; 5, 5′, female anal segment, epiproct and hypoproct; 6, 6′, ovipositor. c, surstylus; e, aedeagus; ep, epiproct; g, epandrium; hp, hypoproct; j, ejaculatory apodeme; m, dorsal mantle of aedeagus; o, basal apodeme of aedeagus; r, vertical rod of aedeagus; t, cercus; v, ventral fragma of novasternum. Scale, 0.1 mm.

3. Male sixth abdominal sternite with two rod-like black projections (Fig. 3).
4. Male epandrium (g) with surstylus (c) (Fig. 4).
5. Male cercus (t) short, oblong in lateral aspect (Fig. 4).
6. Ejaculatory apodeme (j) with stalk medially broadest (Fig. 4).
7. Female epiproct (ep) and hypoproct (hp) triangular in lateral aspects (Fig. 5).
8. Ovipositor blade-like (Fig. 6).
9. Testis (te) apically rounded; paragonia slender and folded, longer than testis (Fig. 7).
10. Spermathecae (th) oblong, not coiled (Fig. 8).
11. Ventral receptacle (re) conical (Fig. 8).
12. Common stalks of Malpighian tubules rather short (Fig. 9).
13. Larvae and puparia with stout black body spicules (Fig. 10).
14. Puparium caudally tapering, with a pair of long spiracles (Fig. 10).

Eggs are elongate elliptical, about 0.70 mm in length, 0.17 mm in width, seemingly without filaments. Often a female fly has its abdomen full of a single egg containing a well-grown first instar larva (especially in Taiwan samples). This phenomenon resembles those reported by WHEELER, TAKADA, and BRNCIC (1962) for the members of the *flavopilosa* species-group, in which a female fly contains a well-developed first instar larva, and by KAMBYSELLIS and HEED (1971) for *Scaptomyza* (*Exalloscaptomyza*) species, in which a female fly ripens only one egg at a time. The latter phenomenon is regarded as adaptation to specialized environment as flowers, or, according to CARSON (1971), ovarian adaptation. KAMBYSELLIS and HEED (*loc. cit.*) found an thorax/egg length ratio of these Hawaiian *Exalloscaptomyza* species considerably low, about 1.2. The figure is the same as calculated by me for the present species. The gregarious habit of the flies of this species would suggest a gregarious oviposition. The overpopulation of larvae might, however, be prevented by this kind of ovarian adaptation.

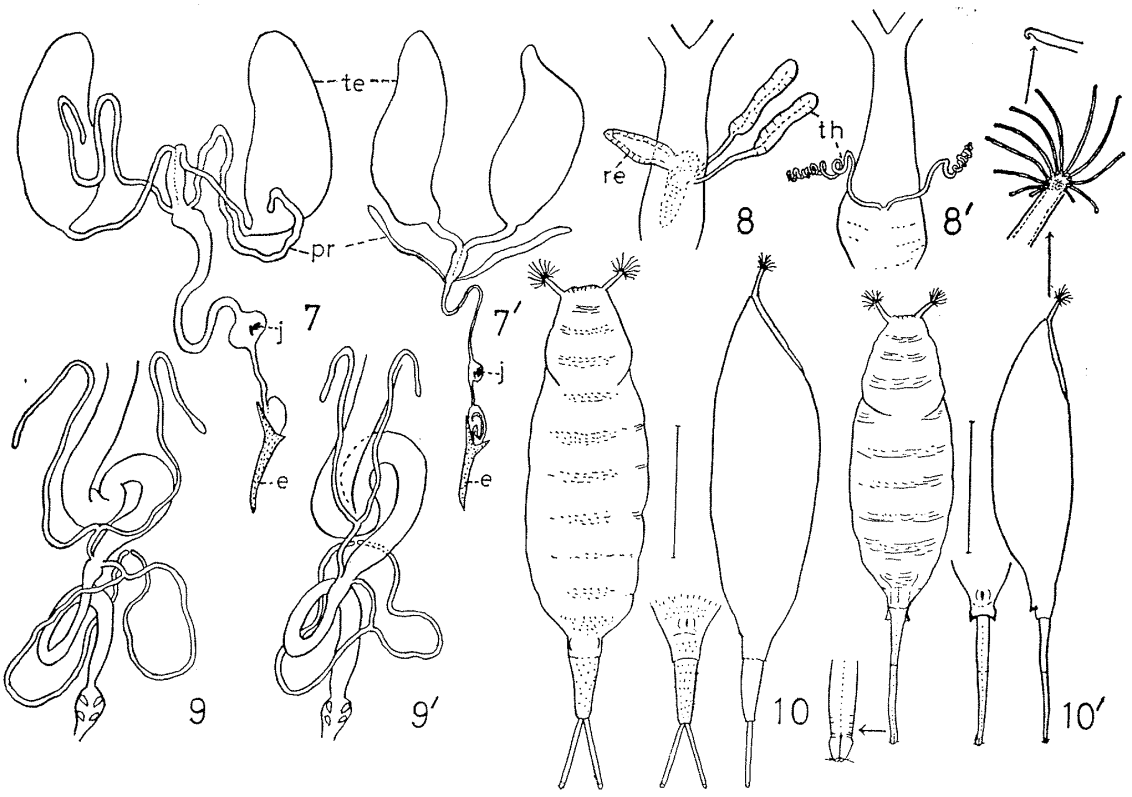
At least in the collection made at Yonehara, the flies of the two *Drosophilella* species were simultaneously swept from one flower (personal information of WATANABE). The observation of infested samples of the flower sent from Okinawa by Miss HONDA revealed, however, that a flower yielded flies of the two species heterochronically. It is suggested that, despite the adult flies might be coexistent, the larvae breed microallopatrically, just fitting to GAUSE's rule.

Distribution. Java, Taiwan (new record), Yaeyama (new record), Okinawa (new record).

Drosophilella alocasiae n. sp.

(Figs. 1′–10′)

Very similar to *D. colocasiae*, having main common features as below. Body about 1.5 mm in length, black in general. Eye with thick piles. Arista pubescent.



Figs. 7–10. *Dosophilella colocasiae* DUDA, and, 7′–10′. *D. alocasiae* n. sp. —— 7, 7′, Male internal reproductive organs; 8, 8′, female internal reproductive organs, ovaries removed; 9, 9′, alimental canal and Malpighian tubules (ventral aspect); 10, 10′, puparia, dorsal, ventral (part), and lateral (contour) aspects. e, aedeagus; j, ejaculatory apodeme; pr, paragonia; re, ventral receptale; te, testis; th, spermatheca. Scale 0.1 mm.

Ocellars arising outside triangle. Carina strong. Cheek very broad. One strong oral. Two unequal humerals. Acrostichal hairs in 4 rows. Cross distance of dorsocentrals subequal to length distance. Two long sternopleurals. Tarsal joints noticeably short, second tarsal joint of fore leg with teeth bearing protuberance. R_{2+3} slightly curved to costa at apex. C-index about 2.0; 4V-index 2.0; 5x-index 1.5; Ac-index 2.5. C1-bristles 2, unequal. Posterior branches of Malpighian tubules closely apposed apically. Testis simple, pale orange. Ejaculatory bulb without caeca. Spermathecae non-sclerotized. Parovaria absent as in Diastatidae (OKADA, 1960), Periscelidae, Milichiidae, Clusiidae, and Lonchaeidae (STURTEVANT, 1926). Ventral teeth of the larval mouth hook absent in the first instar, one median in the second, about 15 small in the third. Anterior spiracle of puparium with about 13 branches in a whorl (13.15 ± 1.20, $n=20$, in *colocasiae*; 12.8 ± 1.03, $n=20$, in *alocasiae*).

However, the present species shows slight but distinct characters discriminative from the foregoing species as below.

1. Costa with heavy bristles sparsely arranged (Fig. 1′).

2. The protuberance of the second tarsal joint of fore leg with five (very rarely six) teeth (Fig. 2′).
3. Male sixth abdominal sternite with a single conical black projection (Fig. 3′).
4. Male epandrium (g) without surstylus (Fig. 4′).
5. Male cercus (t) long, oval in lateral aspect (Fig. 4′).
6. Ejaculatory apodeme (j) with stalk apically broadest (Fig. 4′).
7. Female epiproct (ep) and hypoproct (hp) crescent in lateral aspects (Fig. 5′).
8. Ovipositor very slender, gimlet like (Fig. 6′).
9. Testis (te) apically somewhat pointed; paragonia short (shorter than testis) or absent (Fig. 7′).
10. Spermatheca (th) thread-like, kinkily coiled (Fig. 8′).
11. Ventral receptacle absent (Fig. 8′).
12. Common stalks of Malpighian tubules rather long (Fig. 9′).
13. Larvae and puparia with fine body spicules (Fig. 10′).
14. Puparium caudally much slender, with a pair of very short spiracles (Fig. 10′).

The absence of male paragonia, as occasionally seen in this species and some Muscidae and Tabanidae in Diptera (IMMS, 1930; HORI, 1960), has not been recorded for Drosophilidae as well as other acalyptrates even by an extensive work of THROCKMORTON (1962).

Out of these fourteen characters, eight (1,4,8–12,14) are considered to be more apomorphic than the corresponding characters of the foregoing species. None of the remaining characters are thought to be plesiomorphic. Thus, this species is certainly more derived than the foregoing one.

Holotype, ♂, and allotype, ♀, Yonehara, Ishigaki Is., Yaeyama Is., 14 June 1973 (WATANABE), 20 ♂, 6 ♀, collected together with the holotype. Wulai, Taiwan, 39 ♂, 79 ♀, 2 August, 1974 (WATANABE). Shuri, Okinawa Is., 7 ♂, 29 ♀, numerous larvae, 11 January, 1975 (HONDA). All the specimens were obtained from the flowers of *Alocasia*.

Distribution. Taiwan, Yaeyama, Okinawa.

Drosophila (*Scaptodrosophila*) *scaptomyzoidea* DUDA

Scaptodrosophila scaptomyzoidea DUDA, 1923: 37 (Type-loc.: Friedrichwilhelmshafen, New Guinea).
—— DUDA, 1924 a: 190, 208; 1926: 70.
Drosophila (*Scaptodrosophila*) *scaptomyzoidea*: WHEELER and TAKADA, 1964: 193.

In April, 1971, Dr. MURPHY observed drosophilid larvae breeding in the fading flowers still attached on the trees of *Marvaviscus* in the campus of the University of Singapore, and succeeded in obtaining 3 ♂, 5 ♀, in laboratory, which are here identified with *D. scaptomyzoidea*. General features including male and female genitalia are as given in literature. I collected 2 ♂ and 3 ♀ at the Botanical Garden, Bogor, Java, 2–4 August, 1971, without confirming ecological sequences.

Distribution. New Guinea, Mariana Is., Caroline Is., Sumatra, Java (new record), Singapore (new record).

Remarks. The species of the subgenus *Scaptodrosophila* thus far associated with flowers are *Drosophila aterrima* DUDA, *D. ebena* GRABER, and *D. pseudoebena* GRABER. BURLA (1954) found the flies of *D. aterrima* on the flowers of *Ipomea, Canna, Hibiscus,* and *Datura* in Ivory Coast. GRAVER (1957) confirmed the larvae of this species breeding in fallen flowers of various plants including melon in Kibati, Congo. He found also the adult flies of these three species to have intestines full of pollens. The drosophilid larvae utilizing *Marvaviscus* flowers have been known by the members of the *flavopilosa* species-group in Panama (PIPKIN, RODRÍGUEZ and LEÓN, 1966).

Addendum: A Flower Visitor

Drosophila (Scaptodrosophila) simplex DE MEIJERE

Drosophila simplex DE MEIJERE, 1914: 266 (Type-locs.: Salatiga, Nongkodjadjar, Wonosobo, Java).
—— DUDA, 1923: 45; 1924 a: 208; 1924 b: 244.

I collected 1 ♂, 4 ♀, identified with this species, from the flowers of *Ipomoea* on a river bed, Pekanbaru, Sumatra, 2–4 August, 1971, although the flower breeding habits were not observed. As *Ipomoea* is known as one of the flowers frequently utilized by drosophilid larvae as well as flies, a possibility of its giving a breeding site to this species of *Drosophila* remains.

A male fly collected in Tugu, Java, 27–30 July, 1971, and another male fly collected in Singapore, 6 August, 1971, by me are likely to belong to this species. They show, however, male phallic organs slightly different from that from Sumatra.

Distribution. Singapore (?), Java, Sumatra (new record), Taiwan.

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Summary

Two closely related species, *Drosophilella colocasiae* DUDA and newly described *D. alocasiae* OKADA were found always coexistent upon the flowers of *Alocasia* in Taiwan, Yaeyama, and Okinawa. Their larvae are, however, apparently micro-allopatric in habitats, found breeding heterochronically in the spadices of this plant. *Drosophila* (*Scaptodrosophila*) *scaptomyzoidea* DUDA was recognized to breed in *Malvaviscus* flowers in Singapore, and *D.* (*S.*) *simplex* DE MEIJERE was supposed to breed in *Ipomoea* flowers.

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