Host Suitability of Wild Cucurbits for Melon Fly, *Dacus cucurbitae* Coquillett, in Hawaii, with Notes on their Distribution and Taxonomic Status[1, 2]

G. K. UCHIDA[3], R. I. VARGAS[4], J. W. BEARDSLEY[3], and N. J. LIQUIDO[5]

ABSTRACT

Previous confusion in botanical and entomological literature concerning the names of certain wild hosts of the melon fly, *Dacus cucurbitae* Coquillett, in Hawaii is discussed, and names currently accepted as correct are provided. The correct name for both wild and cultivated forms of bittermelon is *Momordica charantia* L. Most previous references to *Sicyos* sp. and "*Sycos*" as melon fly hosts in Hawaii probably represent misidentification of *Cucumis dipsaceus* Ehrenberg ex Spach.

Rearings from collections of fruit of wild Cucurbitaceae showed that, in addition to *M. charantia*, *C. dipsaceus*, *Sicyos pachycarpus* Hooker and Arnott, and *Coccinia grandis* (L.) Voigt can serve as hosts for *D. cucurbitae*. Of these, *C. dipsaceus* and *S. pachycarpus* appear to be less important, as flies apparently can only develop in immature fruit, which are available for a relatively short time before becoming hard and unsuitable. However, *C. grandis* is a hardy, rapid-growing, weedy vine that produces abundant fruit, which is an excellent melon fly host. This vine is a relatively recent introduction into Hawaii and is presently confined to Oahu and the Kona District of Hawaii island. However, it is spreading rapidly and is likely to become a major reservoir host for the melon fly.

The melon fly, *Dacus cucurbitae* Coquillett[6] (Figs. 1 A, B), was first found in Hawaii about 1895, and thereafter became a serious economic pest of melons, squashes, cucumbers, peppers, beans and tomatoes (Back and Pemberton 1917). Because of recent interest in the possibility of eradicating economically important tephritid fruit flies from the Hawaiian Islands, investigators have sought more information on the role of uncultivated plants as reservoirs for melon fly populations. Several investigations recently have examined the role of feral bittermelon, *Momordica charantia* L., in

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[2]Research supported in part by California Department of Food and Agriculture Grant No. 88-0600 and State of Hawaii, Department of Agriculture.
[3]Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822.
[4]Tropical Fruit and Vegetable Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, P.O. Box 2280, Honolulu, Hawaii 96804.
[5]Tropical Fruit and Vegetable Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, P.O. Box 4459, Hilo, Hawaii 96720.
[6]Drew (1989) in a recent revisionary work placed the melon fly as *Bactrocera (Zeugodacus) cucurbitae* (Coquillett).

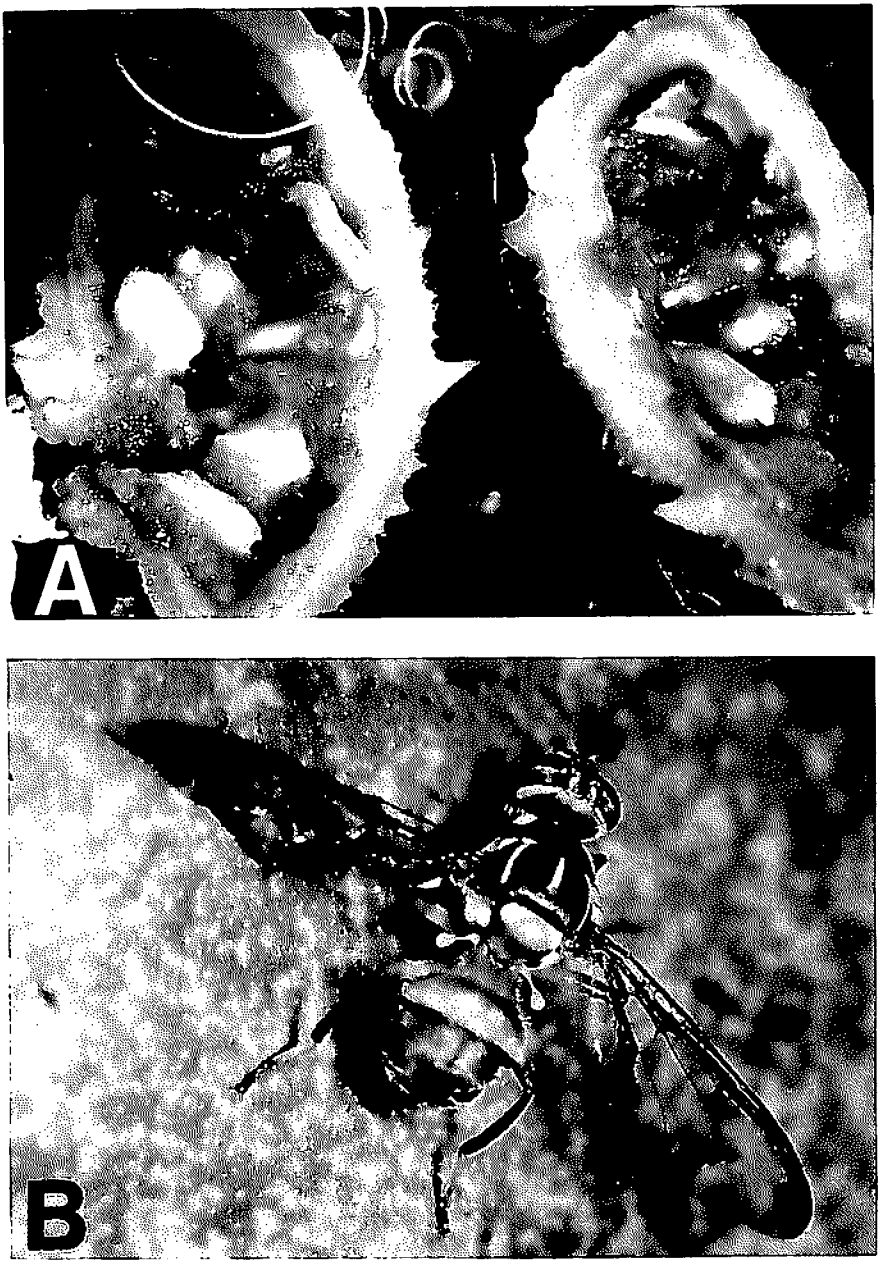

FIGURE 1. Melon fly, *Dacus cucurbitae* Coquillett. (A) Larvae infesting fruit of balsam pear, *Momordica charantia* L. (B) Adult melon fly.

the melon fly population development (Harris et al. 1986, Harris and Lee 1989).

The apparent misidentification of one feral melon fly host, *Cucumis dipsaceus* Ehrenberg ex Spach, as *Sicyos* sp., which was misspelled as *"Sycos"* by some authors (Van Dine 1906, Severin et al. 1914), led to confusion in entomological literature concerning the suitability of both *C. dipsaceus* and the Hawaiian species of the genus *Sicyos* as melon fly hosts. In view of the importance of uncultivated reservoir hosts in carrying over fruit fly populations during periods when cultivated hosts are not available, we considered the clarification of the identity of these plants and their suitability as hosts for melon fly to be necessary for the proper understanding of the phenology of this pest in Hawaii.

In addition to *C. dipsaceus* and *Sicyos* spp., we also evaluated the suitability of the scarlet-fruited gourd, *Coccinia grandis* (L.), as a melon fly host. *C. grandis* is of particular concern because it is a weed which became established in Hawaii quite recently, and is spreading rapidly. The fruit of this vine is a good host for melon fly, and it has the potential to become a major wild reservoir for that pest.

MATERIALS AND METHODS

The Hawaiian botanical and entomological literature were reviewed to trace the history of the misuse of scientific and common names of *M. charantia, C. dipsaceus,* and *Sicyos* and to determine the currently correct usage of these names.

Fruit samples of *M. charantia, C. dipsaceus, Sicyos* spp., and *C. grandis* were collected at random twice per week from near sea level to 1,220 m elevation on the islands of Kauai, Oahu, Molokai, Maui, and Hawaii and held at the University of Hawaii, Manoa, Department of Entomology. The fruits, except for *Sicyos* spp., were placed in wooden frames (39.4 × 27.9 cm) with screen bottoms (0.6 cm mesh) lined with newspaper, which were placed in fiberglass boxes (Plexton containers SN1812-6, 50.2 × 31.8 × 46.7 cm, 0.02 m^3). Each of the fiberglass boxes were filled with fine vermiculite to 1 cm height. The fruits were held for 4 weeks and the vermiculite was sifted each week to remove the larvae and pupae which were transferred to paper packages (4.1 × 2.6 × 7.2 cm) and held for 1 month. The number of *C. cucurbitae* were counted and recorded. This method of holding fruit is a variation of those of Vargas et al. 1983 and Wong et al. 1983. The number of emerged adults per kg of fruit was used to determine the relative importance of each as hosts for melon fly.

A different method for holding the infructescences of *Sicyos* spp. was used since the fruits usually dried out long before the melon fly larvae completed their development. The infructescences of *Sicyos* spp. were sealed in plastic zip-lock bags for 14 days and transferred to 7 oz. plastic cups (Highland Plastic No. ES309) which were held in 30 oz. screen covered plastic containers (Highland Plastic No. CS408) with a 1 cm layer of vermiculite.

RESULTS

Taxonomic Status of Species of *Momordica* (Cucurbitaceae).

M. charantia L. is native from Australia to Africa. In Hawaii, the cultivated form is edible and nutritious (Degener and Greenwell 1947; Telford 1990). The wild form is less edible and is used as a purgative in southern Asia (Degener and Greenwell 1947). In Hawaii, *M. charantia* fruits year round and fruit production peaks during the months of April to July (Newell et al. 1952).

Back and Pemberton (1917, 1918) reported *Momordica* sp., "chinese cucumber," as a host plant of the melon fly. They considered the weedy form of *Momordica* as having escaped cultivation. McBride and Tanada (1949), in their list of Hawaiian host plants, used the names *Momordica charantia* L., "balsam pear," for the cultivated species, and *M. balsamina* L., "balsam apple," for the naturalized species. Newell et al. (1952), Nishida (1953) and Harris et al. (1986) referred to the wild host of the melon fly as *M. balsamina.*

Linneaus (1753) published the original descriptions of *M. charantia* and *M. balsamina* which are translated from Latin to English as follows:

M. balsamina — pome angled tuberculate, leaf glabrous outspread-palmate.

M. charantia — pome angled tuberculate, leaf villose-longitudinal palmate.

FIGURE 2. Balsam pear, *Momordica charantia* L. (A) Flower. (B) Flower bract near base of peduncle.

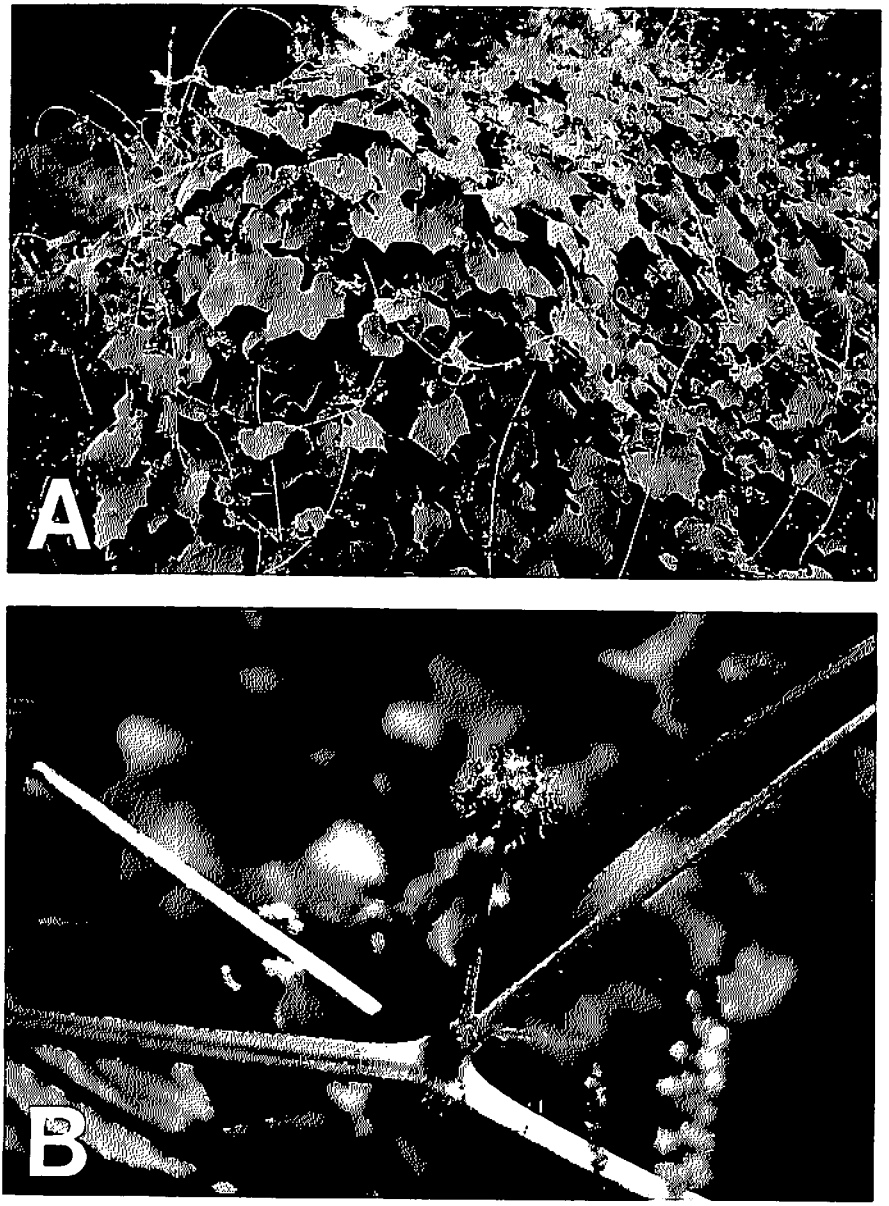

FIGURE 3. Kupala, *Sicyos pachycarpus* Hooker and Arnott. (A) Vine. (B) Immature infructescence.

Pope (1929) was the first to use the name *M. charantia,* "balsam pear," for the cultivated form which bears large, edible fruit, and *M. balsamina,* "balsam apple," for the naturalized form which bears smaller, less palatable fruit. St. John and Hosaka (1932) used the names given by Pope (1929) for the weedy species, but they also published a common name, "mynah-uri." However, Degener and Greenwell (1947) considered *M. charantia* to be the only species of *Momordica* present in the Hawaiian Islands. Degener and Greenwell determined that Hawaiian specimens labeled as *M. balsamina* in the herbarium of the New York Botanical Garden were misidentified because they possessed a bract midway or at the base of the flowering peduncle, as in *M. charantia* (Figs. 2 A, B), rather than at the top. They referred the cultivated variety to *M. charantia* L. var. *charantia,* "balsam pear" or "ku kua," and the naturalized variety, previously reported in the Hawaiian literature as *M. balsamina* (Pope 1929, St. John and Hosaka 1932), as *M. charantia* var. *abbreviata* Ser. Degener and Greenwell characterized the latter variety as less hairy, with smaller, less sharply cut leaves, and smaller, more roughly warty fruit than *M. charantia* var. *charantia.* Neal (1965) treated both the cultivated and weedy forms of *Momordica* as *M. charantia,* and used the common names "bitter melon," "balsam pear," and "fuqua." Haselwood and Motter (1966) used the name *M. charantia* var. *pavel* Crantz, "balsam apple" and "peria," for the weedy forms. St. John (1973) recognized *M. balsamina* as "balsam apple," and two varieties of *M. charantia: M. charantia* var. *charantia* as "balsam pear," "bitter melon," and "fuqua," for the naturalized, small fruited form, and *M. charantia* var. *pavel,* "balsam apple" and "peria," for the cultivated large fruited plant. In Telford's (1990) treatment of Cucurbitaceae, he determined the Hawaiian species to belong to *M. charantia* and used the common name balsam pear for both forms.

In conclusion, the cultivated form of *Momordica* was identified as *M. charantia* and the wild form as *M. balsamina* before 1947 in the Hawaiian botanical literature. However, since both forms possess villose leaves and a bract on the lower half of the flowering stalk, they both belong to the species *Momordica charantia.* Apparently, entomologists were unaware of the changes made in botanical publications after 1946, and the citing of earlier entomological literature has resulted in the incorrect use of the name, *M. balsamina,* which has persisted in the Hawaiian entomological literature.

Misidentification of *Cucumis dipsaceus* Ehrenberg ex Spach[7] as *Sicyos* L.

The genus *Sicyos* L. (Hawaiian name: anunu) (Figs. 3 A, B) in Hawaii contains 14 endemic species (Telford 1990) which are known to various islands of the Hawaiian Archipelago, from Kure Atoll in the northwest to Hawaii island in the southeast. *Cucumis dipsaceus* Ehrenberg ex Spach (Figs. 4 A, B) is a native of eastern Africa. Fruit of the latter are spiny, extremely

[7]The authorship, Ehrenberg ex Spach, is explained as follows: the original description of *Cucumis dipsaceus* was published by Spach, but initially, Ehrenberg recognized it as a new species.

bitter to the taste and poisonous (Degener 1934). This plant was first collected in Hawaii by Bryan on the island of Oahu in 1903 (Telford 1990). By 1911, it was naturalized on all of the other major Hawaiian Islands (Degener 1934). Common names of *C. dipsaceus* used in the Hawaiian botanical literature are "wild spiny cucumber" (Pope 1929, Haselwood and Motter 1966), "wild cucumber" (Neal 1965, St. John 1973), teasel gourd and hedgehog gourd (St. John 1973, Telford 1990).

Pope (1929) indicated that the name *Sicyos* had been incorrectly applied to the naturalized weed, *C. dipsaceus* Ehrhart. Degener (1934), Neal (1965), and Haselwood and Motter (1966) also published the name as *C. dipsaceus,* but they recognized the author as Ehrenberg rather than Ehrhart as used by Pope (1929). St. John (1973) and Telford (1990) used the correct author Ehrenberg ex Spach.

Van Dine (1906, 1908) was the first to report on hosts of the melon fly in Hawaii. Larvae were reared from fruit of a plant he referred to as *"Sycos"* sp. ("wild cucurbit"). Severin et al. (1914) included the name *"Sycos"* sp. ("wild cucurbit") in their list of host plants, citing Van Dine (1908). Back and Pemberton (1917) published a photo of wild host resembling *C. dipsaceus* and identified it as *"Sycos."* Back and Pemberton (1918) considered this weed to be an occasionally infested host of the melon fly. McBride and Tanada (1949) were the first to question the misspelling of *"Sycos"* sp. of Van Dine (1906, 1908), Severin et al. (1914), and Back and Pemberton (1917, 1918), and suggested that the name *Sicyos* be used. However, they did not indicate whether they had confirmed the plant to be a melon fly host. Nishida (1953) cited Pope (1929) and recognized *"Sycos"* as a misidentification of *C. dipsaceus* Ehrhart, but he did not cite Degener (1934) and was unaware of the author Ehrenberg. Harris et al. (1986), citing Back and Pemberton (1918) and McBride and Tanada (1949), used the name *Sicyos* sp. to refer to fruit of a native cucurbit used in their study on the island of Kauai. However, they were unsuccessful in rearing melon flies from it, and considered *Sicyos* to be an unimportant host on Kauai. Vargas et al. (in press), citing Nishida (1953), correctly identified field collected fruit as *C. dipsaceus* Ehrenberg ex Spach ("spiny cucumber") and suggested that this host is a significant factor in melon fly abundance.

In summary, the use of the name *"Sycos"* in the entomological literature probably was the result of a misspelling of *Sicyos,* since there is no genus *"Sycos"* in the plant kingdom (Willis 1973). This error was perpetuated in the entomological literature (Van Dine 1906, 1908; Severin et al. 1914; Back and Pemberton 1917, 1918), until McBride and Tanada (1949) published the correct spelling. However, there is no evidence in the literature to determine if Van Dine's (1906, 1908) melon fly host, *Sycos* (=*Sicyos*) was correctly identified, or was mistaken for *C. dipsaceus.* Back and Pemberton's (1917, 1918) apparent misidentification of *C. dipsaceus* as *"Sycos"* cannot be considered as unexpected since Pope (1929) determined that *C. dipsaceus* had been often incorrectly called *"Sicyos."*

Melon Fly Emergence from *Sicyos* spp. and *Cucumis dipsaceus*.

From the literature review presented above, there was no doubt that *C. dipsaceus* was a melon fly host, but there was some doubt as to the suitability of *Sicyos* spp. Therefore, *Sicyos* fruit were collected in the field and held for melon fly emergence. Also, fruit of *C. dipsaceus* were collected and held in the same manner to obtain data on this species, and to compare the potential of *C. dipsaceus* and *Sicyos* spp. as reservoir hosts.

Fruit collection and adult melon fly emergence data for 3 species of *Sicyos; S. pachycarpus* Hooker and Arnott, *S. lasiocephalus* Skottsberg, and *S. erostratus* St. John, and for *C. dipsaceus* are presented in Tables 1 and 2. Fruit were collected on Kauai from February 1 to November 31, 1988, and on Oahu, Molokai, Maui and Hawaii from March 1 to May 25, 1989. *Sicyos pachycarpus* (Table 1) was determined to be a melon fly host. The single collections made of the other two *Sicyos* species did not yield any flies. The mean number of adult melon flies reared per kg of *Sicyos* fruit was 12.5 (Table 1), whereas fruit of *C. dipsaceus* yielded 5.8 melon flies per kg of fruit (Table 2).

TABLE 1. Fruit collection data and melon fly emergence of species from *Sicyos* L.

Host species	Locality	No. of Collections	No. of Infruc.	Infruc. Weight (g)	Flies/kg of Fruit
S. pachycarpus	Oahu, Campbell Industrial Park	1	90	118.6	0.0
	Makua	1	62	43.3	0.0
	Mokuleia	4	455	363.2	22.2
	Molokai, Kaunakakai	1	98	112.0	0.0
	Maui, Haleakala Highway	1	135	171.6	0.0
	Iao Valley	1	297	426.5	9.4
	Kanaio	1	135	171.8	81.0
S. lasiocephalus	Hawaii, Puuwaawaa	1	84	63.5	0.0
S. erostratus	Puuwaawaa	1	55	29.2	0.0
TOTAL			1,411	1,499.7	112.6
MEAN			156.8	166.6	12.5

TABLE 2. Fruit collection data and melon fly emergence of species from *Cucumis dipsaceus* Ehrenberg ex Spach.

	Locality	No. of Collections	No. of Fruit	Fruit Weight (g)	Flies/kg of Fruit
Kauai,	Kekaha	5	277	8,975.1	2.5
	Mana	10	228	12,204.3	15.4
Oahu,	Campbell Industrial Park	4	70	1,989.1	3.0
	Makaha Valley	1	11	415.7	14.4
Hawaii,	Kailua	1	28	1,170.3	0.0
	Milolii	1	20	630.3	0.0
TOTAL			634	25,384.8	35.3
MEAN			105.7	4,230.8	5.8

The emergence data from Tables 1 and 2 suggest that the fruit of *S. pachycarpus* (Hawaiian name: kupala) is a much better host of the melon fly than *C. dipsaceus*, but we feel that these results may be misleading. *Sicyos pachycarpus* and *C. dipsaceus* are annuals and the fruits tend to persist on the vines during most or all of the growing season. Our rearing records suggest that green, immature fruits of both species support fruit fly larvae, rather than the more mature fruits. In addition, Herbst (pers. comm.) suggested that the length of time required for fruit maturity in *Sicyos* may affect melon fly larval survival. Except for 2 species, *Sicyos alba* (St. John) Telford and *Sicyos cucumerinus* A. Gray, the fruit of Hawaiian species of *Sicyos* become hard and dry as they mature and ripen. In order for *Sicyos* to be a reservoir host, the melon fly larvae must complete their development and leave the host for pupation before the fruits dry up. Thus, the stage and length of development of the fruit may be important considerations for adult melon fly host suitability studies. We feel that this explains, in part, the absence of melon flies in some of the collections of *Sicyos* and *C. dipsaceus*, but more information is needed to confirm this hypothesis. Furthermore, the fruits of *S. erostratus* and *S. lasiocephalus* were very hairy and this may have prevented oviposition by the melon fly. Data for these species is limited to single collections of relatively small numbers of fruits, and additional fruit collections of these species need to be made.

Distribution of *Coccinia grandis*.

Coccinia grandis (L.) Voigt (Cucurbitaceae), ivy or scarlet-fruited gourd, is native to Tropical Asia, Malaysia, and Australia (Telford 1990). This herbaceous liana has a perennial, tuberous rootstock and produces annual stems (Telford 1990) which can completely cover shrubs and trees (Fig. 5 A). The ripe fruits are scarlet in color and cylindrical in appearance (Fig. 5 B). The fruits are edible and are reputed to have medicinal value (Ramachandan and Subramaniam 1983). Several cultivars of the sweet type of *C. grandis* are grown for their fruit in the warmer areas of India, and are consumed either raw or cooked. The people of India value the plant as a treatment for diabetes. All parts of the plant are utilized for treatments of various ailments. Linney (1986) reports that both shoot tips and fruits are consumed as food in Asia.

Linney (1986) was the first to report on *C. grandis* in Hawaii. He stated that seeds (acc. no. L-69.296) of *C. grandis* were received and seedlings were produced at Harold L. Lyon Arboretum in 1969 on the island of Oahu. Part of the seedlings were cultivated by Foster Botanic Garden but, eventually, they were destroyed. However, according to Hirano (pers. comm.), the first plants were planted on the grounds of the Lyon Arboretum in 1970 and the first specimen bearing flowers was collected by Herbst and Ishikawa (5048, HLA) in 1974. In the spring of 1985, feral *C. grandis* was collected by Smith in Keolu Hills in Kailua. In August of 1985 and later, *C. grandis* was observed growing wild in Manoa and Makiki. Nagata (1988) reported collections from the Punchbowl area in 1968, Lyon Arboretum in 1974,

FIGURE 4. Teasel or hedgehog gourd, *Cucumis dipsaceus* Ehrenberg ex Spach. (A) Vine. (B) Green, unripe fruit.

Waihee in 1982, and Enchanted Lakes in 1986, and more recently in Waimanalo. Char (Smith 1989) observed *C. grandis* at the Kahuku Sugar Mill and the northwest side of Sea Life Park in Makapuu.

Specimens of *C. grandis* were examined at herbarium collections of the Bishop Museum and the Harold Lyon Arboretum. The earliest collection of *C. grandis* was made by Nagata (Nagata coll. no. 365, HLA) on May 22, 1968 in the Punchbowl area. Apparently, Linney (1986) was unaware of Nagata's 1968 voucher specimen (Nagata 1988). The herbarium sheet of this specimen bears the Harold Lyon Arboretum No. 8226.

Linney (1986) reported that the first observance of *C. grandis* on the island of Hawaii which was made by C. Corn at Kamoa Point in Kona in September of 1986. In November of 1986 it was discovered in Kailua town in North Kona by Linney. Linney (1989) also observed *C. grandis* in Kona Acres and Kona Palisades Estates in Kailua.

Our survey of *C. grandis* from November 1988 to June 1989 on the island of Oahu determined this plant to be distributed along the Leeward Coast from Hawaii Kai in the east to Waianae in the west. On Windward Oahu, *C. grandis* was found from near Kaiona Beach Park in Waimanalo to Heeia State Park in Heeia Kea, and in Haleiwa and Waialua. An isolated population was observed in Malaekahana State Recreational Park in Laie. The altitudinal range of *C. grandis* on Oahu is from near sea level to ca. 245 m elevation on Mt. Tantalus.

A brief survey on the island of Hawaii on April 20-21, 1989, determined the distribution of *C. grandis* in Kona to extend from Kalaoa to Kealakekua in Kailua. The altitudinal range in Kona was from sea level in Kailua Town to ca. 245 m in the Kona Palisades Estates subdivision in Kalaoa.

Coccinia grandis grows vigorously during the winter months, often covering trees and power lines, and is commonly associated with mature stands of koa-haole, *Leucaena leucocephala* (Lam.) de Wit (Leguminosae: Mimosoidae). On Oahu and Hawaii, *C. grandis* has a more restricted range than *L. leucocephala* and tends to occur as smaller, more scattered populations. The highest concentrations of *C. grandis* were found in Waimanalo and along Quarry Road in Kailua on Oahu, and along Alii Drive in Kailua, Kona on Hawaii. *Coccinia grandis* was usually observed growing in areas where the soil remained relatively moist due to runoff after rains, such as along roadside ditches, vacant lots, and at the edges of tall vegetation, usually koa-haole. Throughout late winter and spring, we noticed *C. grandis* sprouting up in new localities within its known range. The rapid spread of this plant can be attributed to the activities of frugivorous birds and humans who grow the plants for the young shoots. The bird most commonly associated with *C. grandis* on Oahu is the red-vented bulbul, *Pycnonotus cafer* (Pycnonotidae). But the red-vented bulbul is not known to occur on the island of Hawaii where other birds may serve as dispersal agents. We have observed many ripe fruits damaged by birds on the vines.

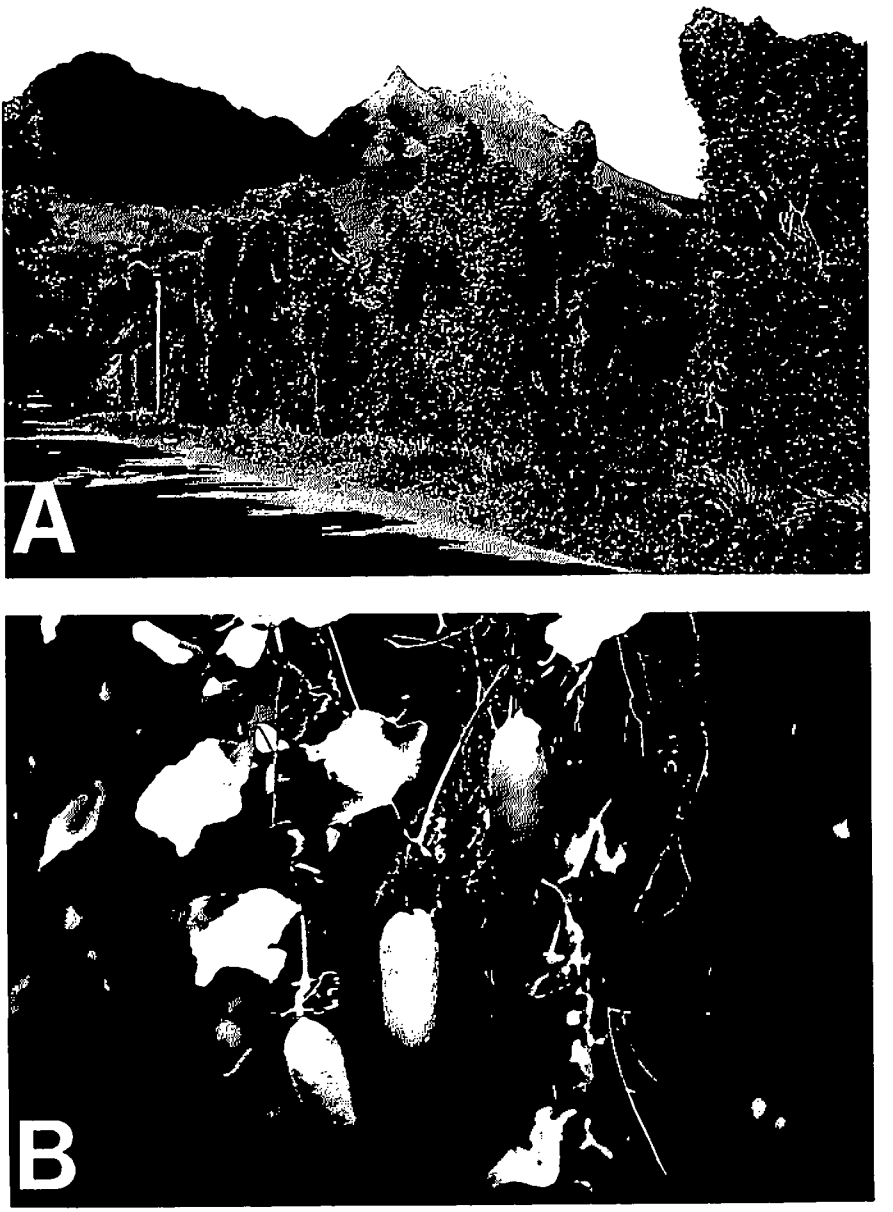

FIGURE 5. Scarlet-fruited gourd, *Coccinia grandis* (L.) Voigt. (A) Vine enshrouding koa-haole, *Leucaena leucocephala* (Lam.) de Wit in Kailua Heights, Oahu. (B) Fruits in different stages of maturity. Green, immature fruit (lower left); full sized, green fruit mottled with a more or less striped pattern (middle); and red, ripe fruit (upper right).

Melon Fly Emergence from *Coccinia grandis*.

C. grandis was determined to be a host for the melon fly in Hawaii during 1988 by Uchida and Beardsley (Unpublished). Their preliminary data showed that *C. grandis* supported an average of 7.7 melon flies per fruit.

Ripe fruit of *C. grandis* were collected in Ewa, Kamilo Nui, Makiki and Waimanalo on the island of Oahu from December 1988 to April 1989, and Kailua and Kalaoa in North Kona on April 20-21, 1989. Twelve collections of *C. grandis* produced a mean of 63.7 adult melon flies per kg of fruit (refer to Table 3), indicating that *C. grandis* is an excellent host of the melon fly.

TABLE 3. Fruit collection data and melon fly emergence of species from *Coccinia grandis* (L.) Voigt.

	Locality	No. of Collections	No. of Fruit	Fruit Weight (g)	Flies/kg of Fruit
Oahu,	Ewa	3	84	1,095.9	254.6
	Kamilo Nui	1	7	68.5	73.0
	Makiki	1	3	77.5	0.0
	Waimanalo	5	124	2,146.3	54.5
Hawaii,	Kailua	1	36	379.9	0.0
	Koloa	1	7	115.6	0.0
TOTAL			261	3,883.7	382.1
MEAN			43.5	647.3	63.7

Comparison of Melon Fly Emergence from Wild Hosts.

Harris et al. (1986) obtained 370 flies per kg of fruit from the wild form of *M. charantia*, and we report 63.7 flies per kilogram of fruit for *C. grandis*, 12.5 for *S. pachycarpus*, and 5.8 for *C. dipsaceus* fruit. Thus, host suitability, in order of decreasing yields of adult flies per kg of fruit, are *M. charantia*, *C. grandis*, *S. pachycarpus*, and *C. dipsaceus*.

From the above data, *M. charantia* is by far the best wild host of the melon fly. The geographical range of *M. charantia* is extensive in the lower elevation on many of the Hawaiian Islands, and its presence throughout the year makes this cucurbit a major reservoir host of the melon fly. On Oahu island, *M. charantia* is observed to be a good pioneer plant because it can quickly become established and may completely cover barren soil, particularly cultivated areas such as sugarcane and pineapple fields, long before other weeds have a chance to become established at the start of the wet season. However, near the end of the wet season, *M. charantia* is frequently out-competed by the taller weeds such as grasses, and although they are present in great numbers, this causes a reduction in number of plants during the wet season. During the drier summer months *M. charantia* flowers set fewer fruits, as compared to the wetter months. *M. charantia* is the most widespread wild cucurbit in Hawaii.

C. grandis ranked second in suitability as a host. However, we feel that *C. grandis* is a very important reservoir host on the islands of Oahu and Hawaii. This liana produces perennial, tuberous roots and large quantities

of annual stems, leaves, and fruit. Furthermore, traps placed near *C. grandis* yielded very high numbers of male melon flies (Harris pers. comm.). According to our observations, *C. grandis* exists in larger and more numerous populations, and is less likely to die back during the drier months of the year, than either *S. pachycarpus* and *C. dipsaceus*. Dieback of large populations of *S. pachycarpus* on the island of Oahu was observed in May 1989 in Mokuleia and near Barbers Point Naval Air Station. On Oahu, a total of six plants of *C. dipsaceus* were discovered in Makapuu, Makaha, Keaau and Campbell Industrial Park. By the end of June 1989, the leaves and stems had either died or showed signs of water stress with an absence of small, immature fruits on the vines. *C. grandis* was also water stressed by the end of June on the Leeward and Windward coasts of Oahu, but leaves and fruits were still being produced. Apparently, the perennial stems of *C. grandis* were capable of producing leaves, stems and fruits rapidly during the short periods of occasional rain that often occur during the drier months of the year. However, at the end of July 1989, *C. grandis* on the island of Hawaii was found to be growing vigorously. There was no evidence of dieback due to water stress and fruits were very abundant throughout its known range. Thus far, *C. grandis* is known from two of the major Hawaiian Islands, Oahu and Hawaii, but its possible spread to the other islands could seriously hamper future efforts to eradicate the melon fly in Hawaii.

SUMMARY

We have attempted to clarify the identity of wild species of Cucurbitaceae in Hawaii which have been reported as hosts or possible hosts of the melon fly, *Dacus cucurbitae*. We have shown that in Hawaii, in addition to *Momordica charantia* which is a well known feral host plant, the melon fly is able to develop in fruits of two introduced weedy vines; *Cucumis dipsaceus* and *Coccinia grandis*. In addition, we reared adult flies from fruits of the endemic vine *Sicyos pachycarpus*. With regard to *C. dipsaceus* and *S. pachycarpus*, it appears that only immature fruits may be suitable for melon fly development as mature fruits become hard and dry and therefore unsuitable. Other species of Hawaiian *Sicyos* may also have the capacity to support development of melon fly larvae when immature, but this has not been demonstrated.

The recent rapid spread of the scarlet-fruited gourd, *C. grandis*, on Oahu and in the Kona region of Hawaii island suggests that this plant may become a major reservoir host for melon fly.

Problems arising from the misidentification of the melon fly hosts in Hawaii, which are discussed in this paper, illustrate the necessity for accurate botanical identifications in all phases of research dealing with insect-plant host relationships. Research workers should seek authoritative determinations of host plant specimens by qualified botanists, and, whenever possible, voucher specimens of host plant material should be preserved, so that confusion due to incorrect or incomplete host plant identifications can be minimized.

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