Taxonomic Status and Host Range of Three *Heteropsylla* spp. (Homoptera: Psyllidae) in Hawaii

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ABSTRACT. The taxonomic status of two species of *Heteropsylla* in Hawaii was clarified after confusion arose because of inadequate identification keys and the collection of mixed populations from a common host plant. A third species of *Heteropsylla* was also discovered for the first time in Hawaii during January 1986.

Host range tests were conducted with nine leguminous plants. *Heteropsylla cubana* Crawford, a senior synonym of *H. incisa* (Sulc), completed its development on leucaena (*Leucaena leucocephala* (Lam.) de Wit) and monkeypod (*Samanea saman* (Jacq.) Merr.); *H. huasachae* Caldwell on koa (*Acacia koa* Gray), monkeypod, and slender mimosa (*Desmanthus virgatus* (L.) Willd.); and *H. fusca* Crawford on klu (*Acacia farnesiana* (L.) Willd.).

Clarification of the taxonomic status of two *Heteropsylla* spp. present in Hawaii was made recently. The close resemblance of the species within this genus, in addition to the collection of mixed populations from a common host plant, led to some early confusion. At that time, the need for revision of the *Heteropsylla* group precluded their identifications. Later, with the revision work completed (Brown 1985, Burckhardt 1986, 1987) and with assistance of collaborators R. Brown and I. Hodkinson[2], D. Burckhardt[3], D. Hollis[4], and D. Miller and L. Russell[5], the determinations of two *Heteropsylla* spp., *H. cubana* Crawford and *H. huasachae* Caldwell, were made. A third species, *H. fusca* Crawford, was later identified by I. Hodkinson, R. Brown, and D. Hollis. A summary of the three psyllids in Hawaii is presented below.

H. cubana Crawford (Figs. 1A-B) is the senior synonym of *H. incisa* (Sulc) (Burckhardt 1986, 1987). *H. cubana* is a new immigrant species to Hawaii and was first collected from leucaena (*Leucaena leucocephala* (Lam.) de Wit) during April 1984 (Nakahara and Lai 1984). This species was previously reported in Hawaiian literature as *Heteropsylla* sp. nr. *fusca* (Crawford) and *Heteropsylla* sp. poss. *incisa* (Sulc) (Nakahara 1986b). Although leucaena is its primary host, *H. cubana* was also later recorded from monkeypod (*Samanea saman* (Jacq.) Merr.) (Nakahara 1988).

H. huasachae Caldwell was first collected in Hawaii from slender mimosa (*Desmanthus virgatus* (L.) Willd.) during May 1975 and was originally referred to as *Heteropsylla* sp. possibly *mimosae* Crawford in Hawaiian literature

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(Beardsley 1977). In April 1984, there was added confusion when this psyllid was also collected from monkeypod for a new Hawaiian host record. Thereafter, it was referred to as *Heteropsylla* sp. nr. *fusca, Heteropsylla* sp. no. 2, and *Heteropsylla* sp. no. 3 (Nakahara 1986a, 1986b, 1988).

H. fusca Crawford is the most recent psyllid immigrant to Hawaii and was first collected from klu (*Acacia farnesiana* (L.) Willd.) during January 1986 (Nakahara 1988).

The recorded host plants in literature (Hodkinson and White 1981) include: for *H. cubana* - *Leucaena glauca* (L.) Benth. (= *L. leucocephala*), *Mimosa* sp., and *Piptadenia* sp.; for *H. huasachae* - *Albizzia lebbeck* (L.) Benth.; and for *H. fusca* - *Acacia farnesiana* and *Haematoxylon campechianum* L.

Since 1984, *H. cubana* has rapidly dispersed and become established in many Pacific island and Asian countries where leucaena is depended on for uses such as animal forage, pelleted feedmeal, firewood, mulching, green fertilizer, shade trees for crops, and erosion control (Mitchell and Waterhouse 1986, Waterhouse and Norris 1987). In Hawaii and some foreign countries, there was much concern for the economic losses to agriculture. Because of the close resemblance of *H. cubana* with the other two *Heteropsylla* spp., proper identifications were essential and accurate host plant relationships needed to be determined. The purpose of this paper is to establish the host range of all three species.

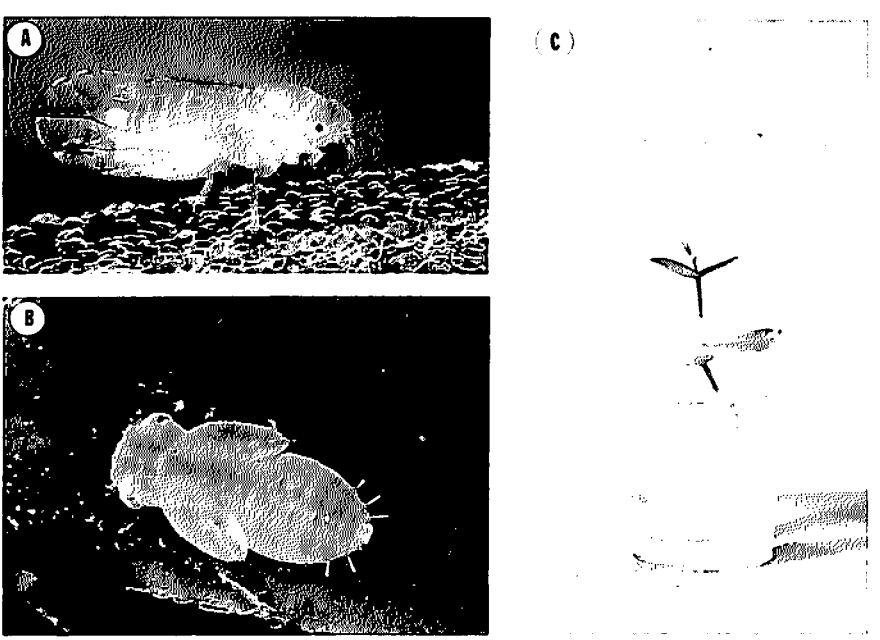

FIGURE 1. *Heteropsylla cubana* Crawford: A, adult; B, late-instar nymph; C, a *Leucaena* seedling in a "rearing vial".

MATERIALS AND METHODS

Stock colonies for the three *Heteropsylla* spp. were established from adults collected from various areas on Oahu. *H. cubana* was collected from leucaena; *H. huasachae* from slender mimosa; and *H. fusca* from klu. The respective host plants from which each psyllid species was collected was designated as the control plant species for testing; however, for *H. huasachae*, monkeypod was substituted for slender mimosa because it was a known host and more easily maintained in the laboratory. Prior to testing, first and second generation adult males from stock colonies were submitted to the Department's taxonomist for species confirmation.

Nine leguminous plant species, representing the subfamilies Mimosoideae and Caesalpinioideae, were used in host range tests with each of the three psyllid species (Table 1). Seeds of test plants were scarified (Takahashi and Ripperton 1949) and sprouted in vermiculite. To encourage egg-laying by female psyllids, seedlings were used during the stage when a set of leaves was beginning to unfurl (Takara et al. 1990). Each trial consisted of a psyllid species and a plant species replicated 4 times with 4 controls. Each replicate consisted of a seedling and a pair of 2-3 day-old adult psyllids confined in a "rearing vial".

A "rearing vial" (Fig. 1C) was constructed by cutting the bottom from a 15-dram plastic vial, and in its place, a piece of fine-meshed organdy cloth was glued on. A 6 mm diameter hole was made in the middle of the plastic vial cap with a cork borer. A strip of wet cotton (ca. 5 × 40 mm) was wrapped around the seedling stem and inserted tightly into the hole of the overturned cap. The modified 15-dram vial was inverted and placed over the seedling terminal, and then the cap snapped shut. The modified vial was then seated on an open 20-dram vial filled two-thirds with water, so that the seedling root was submerged. All "rearing vials" were kept in the insectary under a growth light with 12 h photoperiod (0630 to 1830) at 25.5°C and 58% RH.

Adult psyllids were collected individually in 1-dram glass vials from stock colonies and sexed by examination under a dissecting microscope; females were segregated from males by their prominent ovipositor. The transfer of a pair of adult psyllids to a "rearing vial" was made within a screened cage (30 × 30 × 30 cm) with a cloth sleeve to prevent escape.

Examinations were made every other day to determine the general progress of psyllid development. If egg deposition and hatching occurred, up to 20 1st-instar nymphs were transferred onto a fresh seedling with a soft, fine brush. Thereafter, these nymphs were again transferred onto a fresh seedling every 2-3 days until adulthood. One pair of 2-3 day-old first generation adults from each replicate was then used to start testing for the second generation. The successful development of two generations by a psyllid species in at least one of four replicates within a trial was the criterion by which a plant was considered a host.

RESULTS AND DISCUSSION

The results of psyllid host range tests are shown in Table 1. *H. cubana* completed its development on both leucaena and monkeypod. Field observations indicated that leucaena cannot tolerate high psyllid populations, and that terminal dieback results when new shoots are attacked. However, monkeypod, a large ornamental shade tree, is usually less affected when its new terminal growth is infested.

H. huasachae completed its development on three plant species. Koa (*Acacia koa* Gray), a native Hawaiian tree, was apparently a poor host since only a few individuals were able to complete each generation. However, *H. huasachae* reproduced well on its other two recorded hosts, monkeypod and slender mimosa, the latter being a common weed.

H. fusca reproduced only on klu, which is one of its recorded host plants. In the field, psyllid populations on this weedy shrub were observed to be at low levels with negligible damage.

In trials having unsuccessful development, adult psyllids survived between 2-13 days on non-host plants; only in one trial did adults die on the

TABLE 1. Results of host range tests for three species of *Heteropsylla*.

Plant species	*cubana*	*huasachae*	*fusca*
MIMOSOIDEAE			
Acacia confusa Merr. (formosa koa)	−[a]	−[c]	−[c]
Acacia farnesiana (L.) Willd. (klu)	−[c]	−[b]	+[ctrl]
Acacia koa Gray (koa)	−[a]	+	−[c]
Desmanthus virgatus (L.) Willd. (slender mimosa)	−[c]	+	−[a]
Leucaena leucocephala (Lam.) de Wit (leucaena or haole-koa)	+[ctrl]	−[b]	−[a]
Prosopis juliflora (Sw.) DC. (mesquite)	−[c]	−[c]	−[b]
Prosopis pallida (Humb. and Bonpl. ex Willd.) HBK (kiawe)	−[c]	−[c]	−[a]
Samanea saman (Jacq.) Merr. (monkeypod)	+	+[ctrl]	−[a]
CAESALPINIOIDEAE			
Delonix regia (Bojer) Raf. (royal poinciana)	−[c]	−[c]	−[c]

\+ = successful development by two generations of a psyllid species.
− = unsuccessful development.
a = no eggs laid by female psyllid.
b = eggs laid by female psyllid but no hatching occurred.
c = nymphs survived only through early instars of first generation.
ctrl = control test plant species.

first day. Adults have been recorded in literature to feed on plant species unsuitable for nymphal development (Hodkinson 1974). In the field, *H. cubana* adults, eggs, and 1st-instar nymphs have been observed on royal poinciana (*Delonix regia* (Bojer) Raf.) and kiawe (*Prosopis pallida* (Humb. and Bonpl. ex. Willd.) HBK.) (Nakahara and Lai 1984).

This study indicated that of the three species of *Heteropsylla* found in Hawaii, only *H. cubana* will complete its development on the agriculturally important *L. leucocephala,* while *H. huasachae* and *H. fusca* can only breed on other weeds and ornamental plants.

REFERENCES CITED

Beardsley, J.W. 1977. Note on *Heteropsylla* sp. possibly *mimosae* Crawford. Proc. Hawaii. Entomol. Soc. 22(3):405-406.

Brown, R.G. 1985. Studies on the taxonomy and ecology of the jumping plant lice (Homoptera: Psylloidea) of Panama. Unpublished CNAA Ph.D. thesis, Liverpool Polytechnic. 600pp.

Burckhardt, D. 1986. Nomenclatorial note on *Heteropsylla cubana* Crawford (Homoptera: Psylloidea), a new pest in Pacific countries. Revue suisse Zool. 93(4):1023-1024.

_____. **1987.** Jumping plant lice (Homoptera: Psylloidea) of the temperate neotropical region. Part 2: Psyllidae (subfamilies Diaphorininae, Acizziinae, Ciriacreminae, and Psyllinae). Zool. J. Linn. Soc. 90:145-205.

Hodkinson, I.D. 1974. The biology of the Psylloidea (Homoptera): a review. Bull. Ent. Res. 64:325-339.

Hodkinson, I.D. and **I.M. White. 1981.** The Neotropical Psylloidea (Homoptera: Insecta): an annotated check list. J. Nat. Hist. 15:491-523.

Mitchell, W.C. and **D.F. Waterhouse. 1986.** Spread of the leucaena psyllid, *Heteropsylla cubana,* in the Pacific. Leucaena Research Reports. 7:6-8.

Nakahara, L.M. 1986a. Note on *Heteropsylla* sp. nr. *fusca* Crawford. Proc. Hawaii. Entomol. Soc. 26:11.

_____. **1986b.** Note on *Heteropsylla* in Hawaii. Proc. Hawaii. Entomol. Soc. 26:15.

_____. **1988.** Note on the *Heteropsylla* species in Hawaii. Proc. Hawaii. Entomol. Soc. 28:7-9.

Nakahara, L.M. and **P.Y. Lai. 1984.** Hawaii Pest Report. Hawaii Department of Agriculture. 4(2):2-8.

Takahashi, M. and **J.C. Ripperton. 1949.** Koa-haole *(Leucaena glauca):* its establishment, culture, and utilization as a forage crop. Univ. of Hi. Agr. Exp. Sta. Bull. 100. 56pp.

Takara, J.M., R.J. Dinker, W.T. Nagamine, and **K.K. Teramoto. 1990.** Biology and reproductive rate of the leucaena psyllid, *Heteropsylla cubana* Crawford. Proc. Hawaii. Entomol. Soc. 30:23-29.

Waterhouse, D.F. and **K.R. Norris. 1987.** *Heteropsylla cubana* Crawford, pp. 33-41. *In* Biological Control-Pacific Prospects. Inkata Press. Melbourne.