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# HOST SPECIFICITY AND BIOLOGY OF *MEGACYLLENE MELLYI* [*COL. : CERAMBYCIDAE*] INTRODUCED INTO AUSTRALIA FOR THE BIOLOGICAL CONTROL OF *BACCHARIS HALIMIFOLIA* [*COMPOSITAE*]

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Biology and host plant specificity of the stem boring cerambycid *Megacyllene mellyi* (Chevrolat) were studied in Brazil to determine its suitability for introduction into Australia for control of the shrub *Baccharis halimifolia* L. Multiple choice host preference testing of plants related to *Baccharis*, of desirable plants from a range of plant families, and of the host plants of other *Megacyllene* species, showed that *M. mellyi* was restricted to *Baccharis* spp. It was introduced into Australia in 1975 and released in 1978. Recoveries were made 3 years after release and some stems were killed, although damage was slight relative to the number of *B. halimifolia* plants in the release area.

Groundsel bush (*Baccharis halimifolia* L.) is a woody shrub, native to the eastern coast of the United States of America. It was introduced into Australia in the latter part of the 19th century (**Bailey**, 1900) and has become a weed in cattle pastures along the eastern coast of Australia between latitudes 24° and 31° S. It has little nutritive value for cattle (**White**, 1936) and is not eaten, apart from occasional browsing on young tips. Where no control measures are undertaken, it will shade out useful pasture plants, eventually forming dense thickets up to 4 m high. Groundsel bush is most commonly controlled with herbicides, but as this is expensive, attempts are being made to control the weed with natural enemies.

Between 1961 and 1963, surveys of insects attacking *Baccharis* spp. were made in North and South America by **Bennett** (1963). In 1967 host-specificity testing of these insects commenced in Florida and in 1969 6 species were introduced into Australia from North America, but these did not control the weed (**McFadyen**, 1978). Subsequently, the search for insects was extended to Brazil. As *B. halimifolia* does not occur there, insects were collected from related species of *Baccharis*. Between 1973 and 1976, a number of *Baccharis* feeding insects were host-tested at Curitiba, Brazil. One of these, the Cerambycid *Megacyllene mellyi* (Chevrolat), attacks *Baccharis* species in Brazil and can kill stems and young plants.

Thus this insect was given high priority for introduction into Australia for the control of *B. halimifolia*. This paper gives the results of biology and host-specificity studies and of its introduction into Australia in 1975.

## LIFE HISTORY

*M. mellyi* has a single generation with a partial 2nd generation each year in the Curitiba region. Adults emerged in summer from December to February and lived *ca.* 5 weeks. They did

not feed, apart from drinking water, and caused no damage to the host plant. Adult longevity at ambient conditions of 15° – 25° C was from 31 to 50 days (m = 41, n = 5) for ♂♂, and from 28 to 38 days (m = 32.8, n = 5) for ♀♀. They were active during the day at temperatures over 15 °C. In ambient conditions, 5 ♀♀ laid an average of 63 eggs each (40-97).

The eggs were laid singly in crevices in the bark of *Baccharis* stems. They hatched after 2 weeks and the young larvae, which require living tissue for development, fed just below the bark in the sapwood. Larval tunnels circle the stem and kill young plants and stems. Small plants (< 1 m high) have been killed by as few as 2 larvae tunnelling in the base. Within a month, larvae began tunnelling in the centre of the stem and descended to the base of the plant, although some mature larvae continued feeding just below the bark. Only a single larva was found in each tunnel. Pupation occurred in larval tunnels. Immature development period was *ca.* 8 months at ambient temperatures in Curitiba. The insect overwinters in the larval stage.

Larvae were lightly parasitised by an Ichneumonid *Labena* sp. (det. **De Santis**, Universidad Nacional de la Plata, Buenos Aires), parasitism being *ca.* 3 % in 200 larvae collected at Curitiba during January 1974.

*M. mellyi* has been found throughout southern Brazil and northern Argentina where its distribution includes coastal and inland tropical and sub-tropical regions from sea level to an altitude of 950 m.

## HOST PLANT SPECIFICITY

### FIELD STUDIES AND LITERATURE RECORDS

Field observations, a literature search and discussions with local entomologists indicated that *M. mellyi* was known only from *Baccharis* spp., principally *Baccharis microdonta* Dc. and less commonly *B. dracunculifolia* Dc. and did not attack any economically important plant. Although *M. mellyi* was never recorded as a pest, several other *Megacyllene* species are well known from a wide variety of plants (table 1). Host plants of these other *Megacyllene* species which were obtainable in Brazil, were included in the host preference testing.

### CAGE TRIALS : MATERIALS AND METHODS

Australian quarantine authorities required that *M. mellyi* be tested against a range of plants related to *Baccharis* and a number of unrelated but economically important plants before the importation of *M. mellyi* into Australia would be considered. Plants tested are listed in table 2. Host plants of other species of *Megacyllene* (table 3) were also tested. If the host plant could not be obtained plants closely related to the host were tested whenever possible.

The host preference cage trials were conducted in small cages 1 $m^3$ in size and in large cages 3 x 2 x 2 m in size under ambient conditions at Curitiba, Brazil. In each small cage, 5 pairs of *M. mellyi* adults were offered a choice of 10 test and 2 host plants and in the large cage, 10 pairs were offered a choice of 52 test plants and 8 host plants. The trial period was 5 days in each case.

Duplicated small cage testing of plants listed in table 2 was conducted in summer 1974 and large cage testing of these plants in autumn 1974. Large cage testing of host plants of other *Megacyllene* species was undertaken in autumn 1975. All large cage tests were run 3 times.

Initially difficulties were experienced in rearing the insect for release. These rearing difficulties have recently been overcome and larvae are now reared in an artificial diet developed by **Harley & Willson** (1968) modified by the substitution of powdered *B. halimifolia* stem for the cellulose of their diet. Oviposition is obtained on cut stems of *B. halimifolia* which are wrapped with a spiral of cloth tape to provide oviposition sites using the method described by **Wollerman** *et al.* (1969) for *M. robinae.*

TABLE 1

*Host plants of* Megacyllene *species other than* M. mellyi

| *Megacyllene* species | Host plants |
|---|---|
| *M. acuta* (Ger.) | *Mimosa scabrella* Benth., *Cassia* spp., *Balfourodendron riedelianum* (Engl.), *Ficus* spp., *Acacia mollissima* Willd., *Tilia* sp. **Silva** *et al.* (1968), **Duffy** (1960), *Machaerium stipitatum* Vog., *Solidago microglossa* Dc. (F. Meyer, Museu Anchieta, Porto Alegre, pers. comm., 1974). |
| *M. falsa* (Chev.) | *Albizia moluccana* Miq., *Sloanea lasiocoma* K. Schumm., *Ficus* sp., *Mimosa* sp., *Jacaranda mimosaefolia* D. Don., *Piptadenia communis* Benth., *Aspidosperma* sp., *Holocalyx glaziovii* **Taub ex Glaziou, Silva** *et al.* (1968), **Duffy** (1960), *Arthrosamea polyantha* (Spreng.), *Lonchocarpus nitidus* Benth., *Forsteronia glabrescens* Muell. Arg., *Serjania* sp. (F. Meyer, pers. comm., 1974). |
| *M. spinifera* (Newman) | *Prosopis* sp., *Populus* sp., *Cydonia* sp., **Duffy** (1953a, 1960). |
| *M. crinicornis* (Chev.) | *Acacia confusa* Merr., *A. nilotica* (L.) Del., *Sapindus* sp., *Prosopis chilensis* (Mol.) Stunz, *Delonix regia* (Bojer ex Hook), *Haematoxylon campechianum* L., *Leucaena glauca* (Lam.) De Wit., *Albizia lebbeck* (L.) Benth., *Fraxinus* sp., **Duffy** (1953). |
| *M. pictus* (Drury) | *Hicoria* sp., *Toxylon* sp., *Fraxinus* sp., *Celtis vitis* A.C. Smith, *Gleditschia* sp., *Morus* sp., **Craighead** (1915). |
| *M. robinae* (Förster) | *Robinia pseudacacia* L., *Carya* sp., *Juglans* sp., *Solidago* sp., **Duffy** (1953a). |
| *M. antennatus* | *Prosopis* sp., *Acacia* sp., **Craighead** (1915). |
| *M. guttata* (Chev.) | *Bulnesia arborea* (Jacq.) Engl., **Duffy** (1960). |
| *M. erythropa* (Chev.) | *Acacia* sp., *Prosopis* sp. **Duffy** (1960). |
| *M. caryae* (Gahan) | *Carya* sp., *Juglans nigra* L., *Pecan* sp., *Hicoria* sp., *Maclura aurantiaca* (Raf.) C.K. Schneid, *Gleditschia triacanthos* L., *Celtis occidentalis* L., *Prosopis* sp., **Duffy** (1953a). |

## RESULTS

In 1 test cage in the first of the small cage tests using plants listed in table 2, 1 egg was laid on peach, 1 on pear and 15 on each of the 2 *Baccharis* species. The test was repeated and 5 eggs were laid on pear, 1 on peach, 1 on grape and 19 on *Baccharis*. The eggs on the test plants hatched within 2 weeks and larvae remained in the stem just below the bark for up to 1 month. Light feeding by larvae was observed on peach, pear and grape ; both peach and pear produced resin at the feeding site. Larvae did not develop in any of these 3 plants and died within a month. Larval tunnels under the bark did not exceed 5 mm in length. Larvae from eggs laid on *Baccharis* during these tests continued developing and tunnelled along the length of the stem. One egg was laid free on a maize leaf, but the larva did not feed on or enter the

TABLE 2

*Plants related to* Baccharis *and economically important plants from a range of plant families tested against* M. mellyi

ANACARDIACEAE
*Mangifera indica* (a) L.
ANNONACEAE
*Annona muricata* (a) L.
BROMELIACEAE
*Ananas comosus* (a) (L.) Merr.
CARICACEAE
*Carica papaya* (a) L.
CHENOPODIACEAE
*Beta vulgaris* L.
CONVOLVULACEAE
*Ipomoea batatas* (L.) Lam.
COMPOSITAE
*Carthamus tinctorius* L.
*Tanacetum cinerariifolium* (Trev.) Sch. -Bip.
*Dahlia* sp.
*Helianthus annuus* L.
*Lactuca sativa* L.
*Vernonia* sp.
*Eupatorium* sp.
*Baccharis microdonta* Dc.
*B. dracunculifolia* Dc.
*B. erioclada* Dc.
SOLANACEAE
*Solanum tuberosum* L.
*Nicotiana tabacum* L.
*Lycopersicon esculentum* (a) Miller
*Capsicum* sp. (a)
CRUCIFERAE
*Brassica oleracea* (L.) Alef.
*Brassica campestris* L.
CUCURBITACEAE
*Cucumis* sp. (a)
*Cucurbita maxima* (a) Duch.
GRAMINAE
*Triticum* sp. (a)
*Saccharum officinarum* L.
*Sorghum* sp. (a)
*Zea mays* (a) (L.)
*Pennisetum clandestinum* Chiov.
LAURACEAE
*Persea americana* (a) Miller
LEGUMINOSAE
*Arachis hypogaea* (a) L.
*Medicago sativa* L.
*Phaseolus vulgaris* (a) L.
*Glycine max* (a) L. Merr
*Leucaena glauca* (Lam.) De Wit.
*Acacia* spp.
*Glycine wightii* (Wight & Arn) Verdc.
UMBELLIFERAE
*Daucus carota* L.
*Apium graveolens* L.
LILIACEAE
*Allium cepa* Vent.
LINACEAE
*Linum usitatissimum* L.
MALVACEAE
*Gossypium* sp.
MYRTACEAE
*Eucalyptus* sp.
MUSACEAE
*Musa* sp. (a)
PINACEAE
*Pinus* sp.
PROTEACEAE
*Macadamia* sp. (a)
PASSIFLORACEAE
*Passiflora* sp. (a)
ROSACEAE
*Fragaria ananassa* Duch.
*Rosa* sp.
*Prunus persica* (a) (L.) Batsch
*Malus domestica* (Borkh.) Mansf.
RUTACEAE
*Citrus sinensis* (a) (L.) Osb.
*Citrus limon* (a) (L.) Burm. F.
VITACEAE
*Vitis* sp. (a)
ZINGIBERACEAE
*Zingiber* sp.

(a) Fruits also tested.

plant. Two eggs were laid on a pineapple fruit, but the larvae did not feed or enter. No eggs were laid on any other test plant. Eggs were laid in each test on *Baccharis microdonta, B. dracunculifolia* and on *B. erioclada* Dc. No adult feeding was observed on any plant or fruit.

In the large cage tests using the plants listed in table 2, eggs were laid only on *Baccharis* spp. In the first 2 trials, eggs were laid on 5 of the 6 plants of *B. microdonta.* In the 3rd test, they were laid on 3 of the 6 plants of *B. microdonta.*

TABLE 3

*Plants tested against* M. mellyi *which were hosts of or closely related to plants attacked by other* Megacyllene *species*

APOCYNACEAE
*Aspidosperma polyneuron* Muell. Arg.
BIGNONIACEAE
*Jacaranda mimosaefolia* D. Don.
COMPOSITAE
*Solidago microglossa* Dc.
JUGLANDACEAE
*Carya* sp.
LEGUMINOSAE
*Acacia decurrens* (Wedl.) Willd.
*Albizia lebbeck* (L.) Benth.
*Cassia* sp.
*Holocalyx glaziovii* Taub ex Glaziou
*Lonchocarpus* spp. (2)
*Mimosa scabrella* Benth.
*Delonix regia* Bajer ex Hook
*Prosopis* sp.
*Piptadenia communis* Benth.
*Piptadenia macrocarpa* Benth.
MORACEAE
*Ficus* sp.
*Morus nigra* L.
RUTACEAE
*Balfourodendron riedelianum* (Engl.)
SALICACEAE
*Populus* sp.
SAPINDACEAE
*Sapindus* sp.
TILLIACEAE
*Sloanea lasiocoma* K. Schumm

In the 1st large cage test with plants attacked by related species of *Megacyllene* (table 3), eggs were only laid on 2 plants of *B. microdonta.* In the 2nd trial, eggs were laid on 3 plants of *B. microdonta,* 1 egg on *Acacia decurrens* (Wedl.) Willd. and 1 egg on *Jacaranda mimosaefolia.* In the 3rd trial, eggs were laid on 3 plants of *B. microdonta* and 1 young larvae was found in *Piptademia communis.* Nevertheless the fact that oviposition did occur on these 3 plants indicated that eggs might be laid on these plants under natural conditions. Consequently it was considered advisable to undertake further tests with these 3 plants.

It was recommended that *M. mellyi* be introduced into Australia for further trials against these 3 plants and in 1975, approval was granted to import this species into Australia. A colony was received on the 11th December 1975 at the Alan Fletcher Research Station. *M. mellyi* was found to develop on *B. halimifolia* but not on *J. mimosaefolia, A. decurrens* or *Acacia spectabilis* A. Cunn. ex Benth.. *P. communis* was not recorded from Queensland or known from New South Wales and was not tested (**B. Willson**, Queensland Department of Lands, pers. comm. 1975).

## DISCUSSION

Adults of *M. mellyi* do not feed and the larvae cannot transfer from one plant to another. The selection by ♀♀ of plants for oviposition was considered to be the most important indicator of host preference. As ♀ oviposition preference was the only host restriction characteristic tested, any evidence that ♀♀ under field conditions would oviposit on plants other than *Baccharis* would have led to *M. mellyi* being rejected as a biological control agent for introduction into Australia. On the basis of initial small cage tests, *M. mellyi* was rejected because its host specificity was regarded as doubtful following oviposition on peach, pear and grape. However, larvae

did not develop on these plants and evidence from literature, local scientists and personal observations strongly indicated that in the field under natural conditions, *M. mellyi* was in fact restricted to *Baccharis* spp. This view was reinforced when it was observed during field collections of larvae that they were restricted to relatively few species of *Baccharis* and that one species, *B. microdonta,* was strongly preferred.

A possible explanation was that the small cage tests did not permit expression of the normal host selection behaviour by the female (**Zwolfer & Harris**, 1971). Indications that this was so were the deposition of eggs free on the leaf of maize and in crevices in the fruit of pineapple, behaviour which is not normal for a species which lays eggs in the crevices of a hard woody stem.

Subsequent large cage testing with the same plants showed that *M. mellyi* only oviposited on *Baccharis.* As the tests in the large cage more closely simulated natural field conditions than did the small cage trials, they were regarded as more reliable.

In the large cage testing, using plants attacked by related species of *Megacyllene*, a strong and repeated preference for *Baccharis microdonta* was shown even though 1 egg was laid on each of *A. decurrens, J. mimosaefolia* and *P. communis.* No repeated preference was shown, for any of these 3 plants indicating that these were not the normal preferred hosts of *M. mellyi* and this was confirmed by the further testing in Australia. These investigations strongly suggested that *M. mellyi* is restricted to *Baccharis.* Approval for release was given by Australian quarantine authorities, and the 1st release was made in 1978.

In 1982, *M. mellyi* was recovered at sites near Brisbane from releases of 900 adults made *ca.* 3 years previously in 1978. Thus, it is likely that this species will become established. Field populations are low, and consequently damage is still relatively slight although some stems have been killed. Over 5000 adults reared as indicated in Methods, were released in 1981.

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## RÉSUMÉ

Spécificité et biologie de *Megacyllene mellyi* [*Col. : Cerambycidae*]
introduit en Australie pour la lutte biologique contre *Baccharis halimifolia* [*Compositae*]

La biologie et la spécificité du cerambycide foreur des tiges, *Megacyllene mellyi* (Chevrolat) ont été étudiées au Brésil afin de déterminer ses aptitudes à l'introduction en Australie pour lutter contre l'arbuste *Baccharis halimifolia* L. Des essais de préférence entre de multiples plantes voisines de *Baccharis,* appartenant à toute une série de familles végétales, et des plantes-hôtes pour d'autres espèces de *Megacyllene* ont montré que *M. mellyi* est inféodé aux *Baccharis* spp. Il a été introduit en Australie en 1975 et lâché en 1978. On l'a recherché 3 ans après le lâcher et observé quelques tiges mortes, mais les dégâts étaient relativement faibles par rapport au nombre de *B. halimifolia* dans la zone du lâcher.

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