BIOLOGY AND HOST-SPECIFICITY OF *STOBAERA CONCINNA* (STÅL) (HOMOPTERA: DELPHACIDAE), A POTENTIAL BIOCONTROL AGENT FOR *PARTHENIUM HYSTEROPHORUS* L. (*COMPOSITAE*)

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Introduction

The neotropical annual weed *Parthenium hysterophorus* L. (Compositae) has become a serious problem in Queensland, Australia following its accidental introduction (Haseler 1976).

Since 1978 the Commonwealth Institute of Biological Control has been carrying out investigations of its natural enemies in Mexico on behalf of the Queensland Department of Lands, with a view to discovering potential biological control agents for use against this weed in Queensland. To date three species have been introduced into Australia and approved for release, the seed weevil *Smicronyx lutulentus* Dietz, the leaf beetle *Zygogramma bicolorata* Pallister and the gall-forming moth *Epiblema strenuana* (Walker). This paper presents the results of studies on another insect feeding on *P. hysterophorus,* the delphacid planthopper *Stobaera concinna* (Stål).

The genus *Stobaera* was revised by Kramer (1973), who lists eleven species, all from North America, and gives a key to species and information on distribution and host plants. *S. concinna* is recorded in the U. S. A. from California, Utah, Arizona, Colorado, Texas, Louisiana and Florida; in Mexico from Oaxaca, Veracruz and Sonora; and from Cuba, the Dominican Republic and Haiti. Data from Californa and Florida indicate that its host plants are *Ambrosia confertiflora* DC and *Ambrosia psilostachya* DC. Host plant records for other *Stobaera* spp. are shown in Table 1.

Specimens reared and field collected from *P. hysterophorus* in the course of the present study were sent to Dr. Kramer at the USDA Systematic Entomology Laboratory and identified as *S. concinna* on the basis of the male genitalia.

Field Observations

S. concinna was generally rare and dense populations were never found in the field. In regular samples taken on experimental plots of *P. hysterophorus* at Apodaca, Nuevo León, individuals were collected from april to october, with the greatest numbers being taken in july and august (see

Table 1. Host- plant records for other species of *Stobaera,* from Kramer (1973)

Species	Host plant (s)
S. pallida Osborn	*Baccharis halimifolia*
S. caldwelli Kramer	*Ambrosia dumosa, A. confertiflora, A. eriocentra, A. acanthicarpa, A. psilostachya, Hymenoclea salsola*
S. bilobata Van Duzee	*?Haplopappus squarrosus*
S. muiri Kramer	*Ambrosia chamissonis*
S. giffardi Van Duzee	*¿Artemisia* sp.
S. tricarinata (Say)	*Ambrosia psilostachyia, A. confertiflora, A. chamissonis, Helianthus argophyllus*
S. affinis Van Duzee	*?Ambrosia* sp.

figure 1). It was collected at sites in Nuevo León, Tamaulipas and the eastern part of San Luis Potosí (near Ciudad Valles). An individual seen on *P. hysterophorus* at Uxmal, Yucatán, also appeared to be *S. concinna,* but was not collected. It was not found on any plant other than *P. hysterophorus,* although given its generally low population density this is not surprising.

Life History

Owing to the low population density in the field, all observations on biology and life history presented here are based on insectary observations. *S. concinna* could be reared easily by placing adults on caged plants of *P. hysterophorus,* and quite dense populations built up in the cages. The following observations on the biology and life history were made:

Eggs. These are slender, spindle-shaped and slightly curved, smooth, whitish and translucent, and measure about 1.76 x 0.44 mm. They are laid in longitudinal rows in the stems of *P. hysterophorus.* The duration of the eggs stage, as estimated by the delay between placing adults on the plants and the appearance of newly-hatched nymphs, ranged from 16 to 33 days. This may be an overestimate as the delay between placing the adults on the plants and the onset of oviposition is not known, although it is not thought to be very great.

Nymphs. These feed on the leaves and finer branches of the plant.

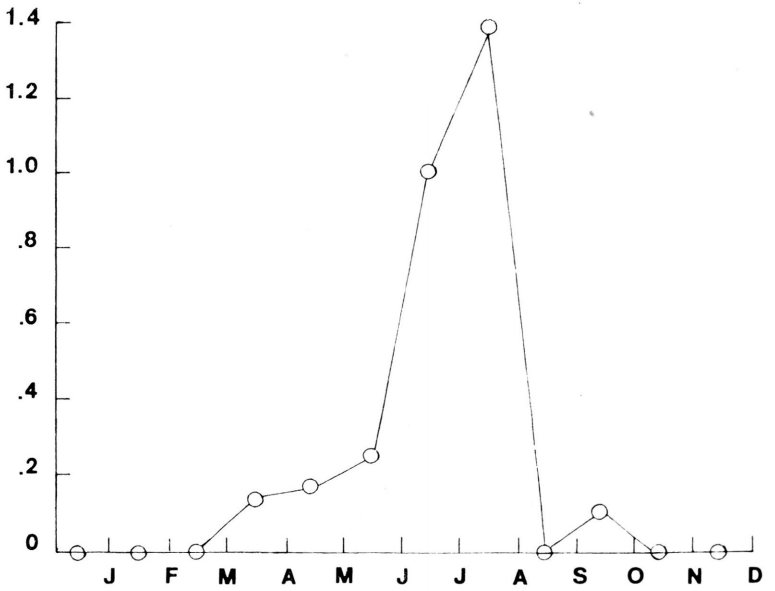

Fig. 1. Mean numbers of *S. concinna* found per sample of 25 plants of. *P. hysterophorus* in plots at Apodaca, N. L. Data from 1979-1982.

Measurements showed that there are five nymphal instars, with females being noticeably larger than males in the fifth instar (see figure 2). The total nymphal development period on *P. hysterophorus* ranged from 14 to 23 days.

Adults. The adults feed mainly on the stems and branches of the plant, but can often also be seen resting on the leaves. They agreed well with the description given by Kramer (loc. cit.) except that no short-winged forms were ever seen. The males are smaller and more strongly pigmented than the females. Females feeding on *P. hysterophorus* and *Ambrosia* developed a marked swelling of the abdomen due to its content of developing eggs. On dissection, some females were found to contain up to 34 almost fully-developed eggs, with many more immature. Adult longevity was not determined exactly but they may live for several weeks.

Effect on Host Plant

The population densities observed in the field were not sufficient to cause any identifiable damage to the plants. At higher densities in cages,

some premature yellowing of leaves occurred on young plants and these became somewhat spindly and unthrifty. One experiment was set up to test whether adults of *S. concinna* could transmit the mycoplasma which is the causal agent of the phyllody disease of *P. hysterophorus* (Phatak *et al.*, 1975). Affected plants were transplanted from the field and 20 adults of *S. concinna* allowed to feed on them in a cage for 7 days. These adults were then transferred to a fresh uninfected plant and allowed to feed. By 39 days after the transfer, no symptoms of the phyllody were seen on the test plant.

Natural Enemies

No observations were made on natural enemies of *S. concinna* during the present study. However, the high population densities which can readily be achieved on caged plants suggest that natural enemies may be responsible for the low densities which occur in the field. The CIBC catalogues (Thompson, 1950) list two species of *Pseudogonatopus* (Hymenoptera, Dryinidae) parasitizing a *Stobaera* sp. in the U. S. A.

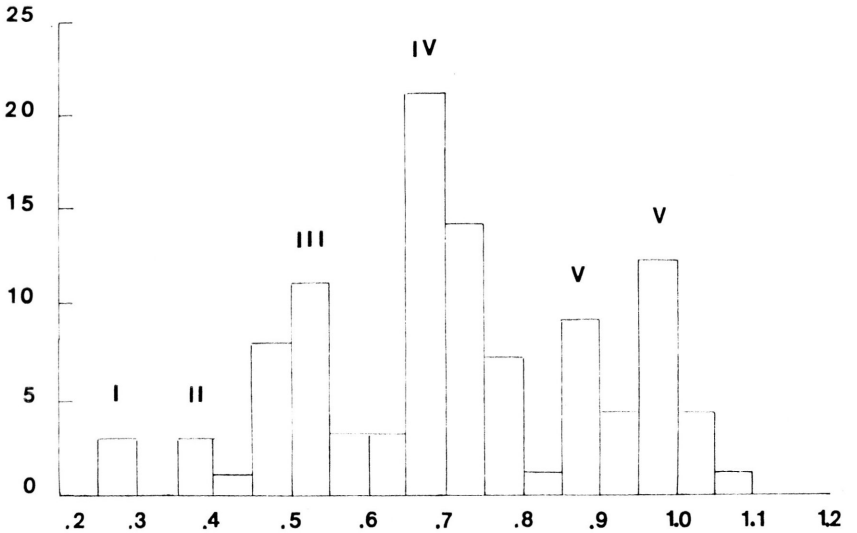

Fig. 2. Distribution of hind tibia lengths (in mm.) of 105 nymphs of *S. concinna* taken from insectary culture. Roman numerals indicate peaks corresponding to instars.

Four host-specificity tests were carried out, the test plants, procedures, and results obtained being as follows:

Experiment 1. A multiple-choice test in which 32 adults were released into a cage containing *Helianthus annuus* (2 plants), *Bidens pilosa* (2), *Parthenium argentatum* (2), *Lactuca sativa* (2), *Cosmos sp.* (2), *Cichorium intybus* (2) and *Ambrosia confertiflora* (3). After 20 days the plants were checked and 10, 36 and 3 recently hatched nymphs were found respectively on the 3 plants of *Ambrosia,* with none on any other plant. The plants were checked again 16 days later, when partly grown nymphs were numerous on *Ambrosia* and none were found on any other plant.

Experiment 2. 10 adults each were placed on separately-caged plants of *P. hysterophorus, Ambrosia, Helianthus, Bidens, Rudbeckia, Cosmos, P. argentatum, Coreopsis lanceolata* and *Cichorium.* After 11 days all remaining live adults were recovered from the cages and females dissected to check for the presence of eggs in their ovaries. Four females recovered from *P. hysterophorus* had respectively 34, 19, 34 and 6 fully developed eggs. Three recovered from *Cosmos* and 2 from *Bidens* contained no fully developed eggs. No adults were recovered alive from any of the other test plants. Nymphs began to hatch on the plant of *P. hysterophorus* after 27 days. No hatching occurred on any of the other test plants.

Experiment 3. 3 males and 3 gravid females were placed on separately-caged plants of each of *P. hysterophorus, Ambrosia, Rudbeckia, Lactuca, Helianthus* and *Coreopsis.* After 23 days, newly-hatched nymphs were seen on *Ambrosia,* and after 25 days on *P. hysterophorus.* No hatching occurred on any of the other test plants.

Experiment 4. A direct check for oviposition in stems of some test plants. Two large glass jars were set up, each containing one bouquet each of *P. hysterophorus, Ambrosia, P. argentatum, Helianthus, Bidens, Coreopsis* and *Heliopsis* sp. with their stems inserted into vials of water which were closed with a cotton-wool plug. Six females were placed in each jar and the jars covered with gauze held on by an elastic band. After 4 days the insects were removed and the stems dissected to check for oviposition. Results were as follows:

Jar 1. 3 females recovered, all resting on *P. hysterophorus.* Egg. counts: 37 in *P. hysterophorus,* 8 in *Ambrosia,* none in any other test plant.
Jar 2. 6 females recovered, all resting on *P. hysterophorus.* Egg. counts: 53 in *P. hysterophorus,* 3 in *Ambrosia,* none in any other test plant.

The *Ambrosia* available at the time of this experiment had rather old and woody stems, and may not have been a very attractive alternative to the *P. hysterophorus*. However all other plants used had fresh stems in comparable condition to those of *P. hysterophorus*. The results of these experiments are summarized in Table 2.

Discussion

The results reported here show clearly that of all the plant species tested, only *P. hysterophorus* and *A. confertiflora* are acceptable hosts for *S. concinna*. No reproduction was observed on any of the other test plant species, females confined on them did not develop the distended abdomen indicating the presence of maturing eggs, and the absence of oviposition in other test plants was confirmed by dissection. The only hosts previously reported for *S. concinna* are *Ambrosia confertiflora* and *A. psilostachya* (Kramer, loc. cit.). The association of *Ambrosia* and *Parthenium* as hosts for a given insect species is very common (McClay, unpublished observations) and indeed two of the species which have already been approved for liberation against *Parthenium* in Australia (*Z. bicolorata* and *E. strenuana*) are capable of completing development on *Ambrosia* spp. As this genus is represented in Australia only by introduced weeds, no harm will be done if insects introduced against *Parthenium* also feed on it.

Table 2. Summary of results of host specificity testing with *S. concinna*

Test plant	Expt. 1 bred?	Expt. 2 bred?	Expt. 3 bred?	Expt. 4 oviposited?
P. hysterophorus	yes	yes	yes	yes
Ambrosia	yes	no	yes	yes
Helianthus	no	no	no	no
Lactuca	no	—	no	—
Cichorium	no	no	—	—
P. argentatum	no	no	—	no
Bidens	no	no	—	no
Cosmos	—	no	—	—
Coreopsis	—	no	no	no
Rudbeckia	—	no	no	—
Heliopsis	—	—	—	no

Of the other species of *Stobaera* listed by Kramer, all those whose hosts are known feed on Compositae, mainly *Ambrosia* spp. (Table 1). Several appear to be restricted to one or a few closely related species of host plants, and none attacks any economic plant. In a search of the CAB ABSTRACTS and BIOSIS databases, no other references to host plants of *Stobaera* spp. were found since the publication of Kramer's paper. This is further evidence of their lack of economic importance. No species of *Stobaera* is mentioned in a list of insects and mites attacking crops in México (García Martell, 1977). The plant species tested in this study include sunflower and two other economic Compositae (lettuce and chicory), as well as species in 6 other genera of the tribe Heliantheae (*Bidens, Cosmos, Coreopsis, Rudbeckia, Ambrosia* and *Heliopsis*), and one other species of *Parthenium* (*P. argentatum,* the guayule rubber plant). These plants were selected in accordance with guidelines, agreed by the Queensland Department of Lands and the Australian Department of Health, for pre-introduction testing of candidate insects for biological control of *P. hysterophorus*.

The potential for damage by *S. concinna* to *P. hysterophorus* is not clear. Populations in the field in México were never high enough to cause identifiable damage; however, the insectary observations suggest that if high population densities could be attained these might reduce the vigour at least of younger plants. Its ability to transmit the *Parthenium* phyllody could not be demonstrated in the limited studies reported here, but further work would be necessary to confirm or refute this conclusion. As was pointed out by McFadyen and Tomley (1981), it is risky to attempt to predict the effect of an introduced biological control agent from observations of its effects in its area of origin, and otherwise suitable organisms should not be rejected simply on the basis of an apparent lack of damage to the host in its native area. With this in mind, and taking into account the results reported here which show that *S. concinna* has a sufficiently restricted host range, approval has been sought and received for its introduction into Australia for further testing under quarantine, with a view to its eventual release against *P. hysterophorus*.

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Abstract

The biology of the planthopper *Stobaera concinna* (Stål) (Delphacidae) on its host *Parthenium hysterophorus* is described on the basis of insectary observations. Eggs are laid in the stems and there are five nymphal instars; total development time from egg to adult ranges from 30 to 56 days. Host-specificity tests showed that it would breed only on *P. hysterophorus* and *Ambrosia confertiflora* out of 11 species of Compositae tested. At high population densities in cages it causes yellowing of leaves and spindly growth of the host plant. It is reported from the states of Nuevo León, Tamaulipas, San Luis Potosí, and probably Yucatán; it is also recorded in the literature from Sonora, Veracruz and Oaxaca. Approval has been obtained for its introduction under quarantine into Australia for testing as a candidate bio-control agent for *P. hysterophorus,* which is a serious introduced weed in the state of Queensland.

Resumen

Se describe la biología del delfácido *Stobaera concinna* (Stål) sobre su huésped *Parthenium hysterophorus,* con base en observaciones hechas sobre poblaciones criadas en laboratorio. Los huevecillos son depositados en los tallos y hay cinco estadíos ninfales; el tiempo total de desarrollo de huevecillo a adulto oscila entre 30 y 56 días. En pruebas de especificidad se demostró que esta especie es capaz de reproducirse únicamente sobre *P. hysterophorus* y *Ambrosia confertiflora* de las 11 especies de compuestas que fueron probadas. En poblaciones densas bajo condiciones de jaula produce un amarillamiento de las hojas y un crecimiento raquítico de la planta huésped. Se encontró en los estados de Nuevo León, Tamaulipas, San Luis Potosí y probablemente Yucatán; en la literatura se reporta también de Sonora, Veracruz y Oaxaca. Se ha aprobado su introducción a Australia para pruebas bajo cuarentena como un agente potencial de control biológico para *P. hysterophorus,* especie que ha sido introducida accidentalmente al estado de Queensland donde es una maleza nociva importante.

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LOS ESTADOS INMADUROS DE *INCA CLATHRATA SOMMERI* WESTWOOD (COLEOPTERA, MELOLONTHIDAE, TRICHIINAE); CON OBSERVACIONES SOBRE EL CRECIMIENTO ALOMETRICO DEL IMAGO.[1]

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