ASSESSMENT OF *PAULINIA ACUMINATA* [ORTHOPTERA : ACRIDIDAE] FOR THE BIOLOGICAL CONTROL OF *SALVINIA MOLESTA* IN AUSTRALIA

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The biology and host specificity of the aquatic grasshopper, *Paulinia acuminata* (De Geer) were studied in quarantine in Australia. Adults and nymphs fed on the leaves of *salvinia* (*Salvinia molesta*), water lettuce (*Pistia stratiotes*) and azolla (*Azolla pinnata*).

Fifty-three plant species representing 38 families were exposed to adults and nymphs of *P. acuminata*. Adult feeding occurred on 17 plants but nymphs failed to feed on 9 of these species in the presence of *S. molesta*. In starvation trials, 14 plants (excluding *S. molesta*, *P. stratiotes* and *A. pinnata*) were attacked by adults, of which only 5 were attacked by nymphs. Heavy feeding occurred on strawberry (*Fragaria x ananassa*) but no oviposition occurred even when the leaves were held in contact with the water surface. The life cycle of *P. acuminata* was completed only on *S. molesta*, *P. stratiotes* and *A. pinnata*. Eggs deposited on water hyacinth (*Eichhornia crassipes*) failed to hatch.

Laboratory evaluation was supplemented with observations on the distribution and abundance of *P. acuminata* on the Zambezi River system, Zimbabwe, during October 1984.

KEY WORDS: *Paulinia acuminata*, grasshopper, biological control agent, *Salvinia molesta*, host specificity, assessment, Africa, Australia.

In Australia, extensive infestations of *Salvinia molesta* Mitchell occur on rivers and lakes in Queensland and New South Wales, while smaller infestations are recorded from Northern Territory and southern Western Australia (Mitchell, 1978; Finlayson, 1984). Two biological control agents, a weevil (*Cyrtobagous salviniae* Calder & Sands) and a moth (*Samea multiplicalis* Guenee) were introduced by CSIRO from Brazil and liberated in Queensland between 1980 and 1982 (Room et al., 1981; Sands & Kassulke, 1984). Control of the weed was rapidly achieved by the weevil on Lake Moondarra, Mt. Isa while the impact of the moth in coastal areas of northern Queensland is currently being assessed (Room et al., 1985).

The aquatic grasshopper, *Paulinia acuminata* (DeGeer) was 1st recommended as a biological control agent for *S. molesta* by Bennett (1966). *P. acuminata* has been recorded from Uruguay, Paraguay, Argentina (Forno, 1981), Brazil and Trinidad, and occurs widely in South America where the host plants, *Salvinia* spp., occur (Bennett, 1966). The grasshopper is known to feed on a number of other aquatic plants including *Pistia stratiotes* L., *Lemma* sp., *Azolla* sp., *Hydromystria* sp., *Spirodella* sp. and *Eichhornia crassipes* (Mart.) Solms but only completes development on *Salvinia* spp., *P. stratiotes*, *Azolla* spp. and *Hydromystria* sp. (Bennett, 1966).
The biology of *P. acuminata* was studied by Chisholm (1979) and Thomas (1980) following its introduction and establishment on Lake Kariba, between Zambia and Zimbabwe. Although high densities of the grasshopper developed and the cover of *S. molesta* on the lake decreased from 10% to 1%, the depletion of the weed was not directly attributed to the grasshopper but was more likely due to changes in the nutrients available (Mitchell & Rose, 1979).

Host specificity studies are reported and field observation in Zimbabwe where *P. acuminata* is established on *S. molesta* in the Zambezi River system.

**MATERIALS AND METHODS**

Nymphs of *P. acuminata* were imported from Rio Guarguacu, Praia de Leste Parana, Brazil for biological and host specificity investigations in quarantine at the CSIRO, Division of Entomology laboratories in Brisbane. The colony was established within a quarantine building which was air conditioned to about 28°C during the day and 22°C at night at 50-70% RH. Overhead fluorescent lighting was provided with a 16 : 8 photoperiod to supplement natural lighting.

**REARING**

Ten pairs of adult *P. acuminata* were placed in rectangular plastic boxes 29 cm × 39 cm × 20 cm containing tertiary-stage (with upright leaves), field collected, *S. molesta* with 10 l of softened water. The top of the container was covered with gauze. Every 7 days plants were replenished. Those on which oothecae of *P. acuminata* had been deposited were removed and placed in separate containers in a nutrient solution until the eggs hatched. Following emergence, nymphs were supplied with fresh *S. molesta* plants each week. Numbers held in each box were regulated according to instar: 50 per box for 1st and 2nd instar, 30 per box for 3rd, 4th and 5th instars and 20 per box for 6th instar and adults.

**HOST TESTING PROCEDURES**

The feeding specificity of *P. acuminata* was studied with newly-emerged nymphs and mature adults. These were tested separately in the presence of the principal host, *S. molesta* in 2 kinds of choice trials. The plants exposed included those tested with *S. multiplicaenis* by Sands & Kassulke (1984). *Monochoria cyanea* (F. Muell.) F. Muell. and *Citrus limon* (L.) Burm. f. were also tested.

*Choice Test 1: cut foliage.* Fresh terminal leaves of each test plant were rested on plants of *S. molesta*, floating on 10 l of softened water held in a plastic box 29 cm × 39 cm × 20 cm with a clear polyethylene top. Fifty newly-emerged nymphs or 5 pairs of adults were placed in each container.

*Choice Test 2: growing plants.* Nine potted test plants were held in cages covered with clear polyethylene sheet to increase the humidity within. The cages measured 45 cm × 45 cm × 90 cm with 10 pairs of mature adults or 100 newly-emerged nymphs placed in each cage. Both choice tests were repeated 3 times for each tested plant species. Leaves and plants were examined daily for 7 days for any evidence of feeding.