

Evaluation of seed-feeding bruchids, *Acanthoscelides* species, as biological control agents for *Mimosa pigra* in Thailand

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Abstract

A project on biological control of giant sensitive plant, *Mimosa pigra* L., in Thailand was initiated by the National Biological Control Research Center, Kasetsart University, in 1980–1981. Five insects were released and two, the seed bruchids *Acanthoscelides quadridentatus* (Schaeffer) and *Acanthoscelides puniceus* Johnson, became established. An evaluation of the effectiveness of these bruchids was carried out during 2001, revealing that on average less than 50% percent of seeds are damaged. This level of damage is unlikely to cause a reduction in mimosa populations in Thailand.

Keywords: mimosa, seed bruchids, *Acanthoscelides quadridentatus*, *Acanthoscelides puniceus*, biological control, Thailand.

Introduction

The invasive shrub mimosa, *Mimosa pigra* L., is native in South America. It was introduced into Thailand from Indonesia in 1947 as a green manure and cover crop by northern Thai tobacco farmers and to control erosion on riverbanks (Napompeth 1983a, Wara-Aswapati 1983). Because of its high productivity and adaptability it has become a noxious weed along rivers, canals, reservoir and swamp areas in the north, and has invaded south to the Central Plain. It continues to spread southwards. Mimosa is one of the worst weeds in Thailand.

In 1980, the National Biological Control Research Center (NBCRC), Kasetsart University,

initiated a project on biological control of this weed. The endemic natural enemies were investigated and evaluated and were found to be ineffective as biological control agents, including coffee borers, *Zeuzura coffeae* Nietner (Lepidoptera: Zeuzeridae) and *Sagra femorata* Drury (Coleoptera: Chrysomelidae) (Napompeth 1983b). Between 1984 and 1991, six species of natural enemies of mimosa were introduced by NBCRC into Thailand from their native region of Central and South America via Australia. They were: *Chlamisus mimosae* Karren, *Neurostrotta gunniella* (Busck), *Carmenita mimosa* Eichlin & Passoa, *Coeloccephalopion aculeatum* (Fall.), and the two seed bruchids *Acanthoscelides quadridentatus* (Schaeffer) and *Acanthoscelides puniceus* Johnson. This was done as part of a program that began in 1984, involving three Australian agencies, the Australian Centre for International Agriculture Research (ACIAR), CSIRO Entomology, and the

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Northern Territory Department of Primary Industry, and two Thailand agencies, the Royal Irrigation Department (RID) and NBCRC. Five were released (not *N. gunniella*), and only two, the seed bruchids, became established (Julien and Griffiths 1999). Another insect, *Mylothris irrorata* (Coleoptera: Cerambycidae), was introduced from Indonesia but was not released (Napompeth 1983b).

The purpose of this study was to evaluate the effectiveness of the seed bruchids as biological control agents.

Materials and methods

Mass-rearing and field release of *Acanthoscelides* spp.

An efficient mass-rearing technique was developed for the two seed bruchids, *A. quadridentatus* and *A. puniceus*. Rearing was conducted at the NBRRC laboratory at Kasetsart University, Bangkok, and at the NBCRC Central Regional Center, Kasetsart University, Kampaen Saen Campus, Nakhon Pathom. About 100 adults were reared in aluminum boxes (24 × 24 × 34 cm) with about 200 mature mimosa pods. Bee pollen and water, offered as water-soaked cotton wool, was continually provided to adults. Small holes were made in the side of the boxes and covered with organza screen for ventilation. A short piece of plastic pipe, 10 cm diameter, was fitted into the top of each box and a plastic bag was sealed over the pipe with a rubber band (Figure 1). The progeny of the adults completed development after about six weeks, congregated in the plastic bags and were collected. The adults of the two *Acanthoscelides* species were then released in the field using the method of Wilson et al. (1992).

Four sites were located for this study, one in each of the following four provinces in the Central Plain: Pathum Thani, Phra Nakhon Si Ayutthaya, Ang Thong and Suphan Buri. At the beginning of this experiment about 6,000, 8,500, 4,000 and 5,000 adults of *Acanthoscelides* spp. were released in each study site, respectively.

Field assessment of *Acanthoscelides* spp.

Field assessments of the effectiveness of *Acanthoscelides* spp. were conducted at the study sites indicated above from February to November 2001. The sampling method used included collecting five infructescences (an infructescence is a single bunch of pods joined at their stalk) from each of five plants within a sampling area. Ten sampling areas were selected randomly at each study site. The sampled pods were kept in plastic boxes, 12 × 12 × 6 cm, for six weeks. The number of adults that

emerged and the total number of seeds and number of damaged seeds were recorded.



Figure 1. Rearing boxes for *Acanthoscelides* species.

Results and discussion

Mass rearing and field released of *Acanthoscelides* spp.

About 40,000 adults of the two *Acanthoscelides* species were produced monthly in the mass-rearing program. The first release was made in 1984 in northern Thailand. Further releases were made throughout the mimosa infestation in Thailand, resulting in widespread establishment (Napompeth 1991). Another 23,500 were released as part of this study.

Field assessment of *Acanthoscelides* spp.

The abundance of *Acanthoscelides* at the four locations between February to November was different (Figure 2), possibly due to the seasonal differences of mimosa. The peak of pod production varied considerably among locations. The peaks of populations for *Acanthoscelides* were highest from February to August at Pathum Thani and highest in February at Phra Nakhon Si Ayutthaya and at February and May for Ang Thong. The populations were similar throughout the study at Suphan Buri. The averaged population levels ranged from 9.5 to 26.5 adults per infructescence.

The number of seeds per infructescence ranged from 157 at Ang Thong to 59 at Phra Nakhon Si Ayutthaya. However, generally there was little difference in seed production between sites at the same month, and overall averages were 112 to 94 (Table 1).

The efficacy of *Acanthoscelides* species as biological-control agents was evaluated by determining the percentage of damaged seeds of mimosa, as shown in Table 2. The highest level of seed damaged was 86.9% in August at Suphan Buri

Province. On 11 of the 16 sampling occasions the damage was below 50%. The average for each site was below 50%.

Conclusion

Mimosa is capable of producing many thousands of seeds per plant each year (Lonsdale *et al.* 1998). To reduce *mimosa* populations by reducing viable seed it would be necessary to prevent most seed from developing or to destroy practically all of the seeds that are produced. The highest percentage

of seed damage recorded was 87%, too low by itself to cause population reductions in *mimosa* even if that level were sustained constantly over all *mimosa*. However, the averages for all locations were below 50% and two sites were less than 25%. This study indicates that the two seed-feeding bruchids are unlikely to have a significant impact on *mimosa* in Thailand. As these are the only biological control agents established in Thailand, additional agents are required if successful biological control of *mimosa* is to be achieved in Thailand (see Flanagan and Julien 2004, Heard

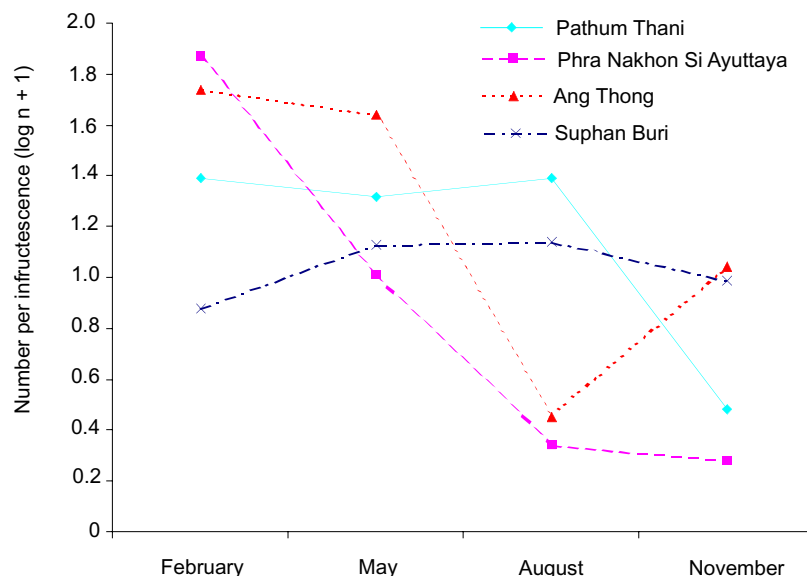


Figure 2. Abundance of *Acanthoscelides* spp. in samples at four locations on the Central Plain of Thailand in 2001.

Table 1. Total seeds and damaged seeds per infructescence of *Mimosa pigra* at four locations on the Central Plain of Thailand in 2001.

	Pathum Thani		Phra Nakhon Si Ayutthaya		Ang Thong		Suphan Buri	
	Total	Damaged	Total	Damaged	Total	Damaged	Total	Damaged
February	134.6	41.4	124.8	73.2	79.6	45.2	97.4	13.1
May	100.4	53.1	101.3	13.0	155.8	41.0	93.1	9.9
August	115.3	89.8	113.9	8.1	102.0	4.3	119.2	103.6
November	98.4	3.9	59.0	3.9	110.7	18.2	65.9	9.4
Average	112.2	45.1	99.7	24.5	112.0	27.4	93.9	34.0

Table 2. The percentage of seed damaged at four locations on the Central Plain of Thailand in 2001.

	Pathum Thani	Phra Nakhon Si Ayutthaya	Ang Thong	Suphan Buri
February	30.8	58.6	56.8	13.4
May	52.8	12.8	26.3	10.7
August	77.9	7.1	4.1	86.9
November	3.9	6.6	16.4	14.3
Average	41.4	21.3	25.9	31.3

and Segura 2004). Then the combined impact of new biological control agents with the impact of the bruchids could reduce mimosa in the future.

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