Biological control of ***water hyacinth***

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The weevils *Neochetina bruchi* and *N. eichhorniae*: biologies, host ranges, and rearing, releasing and monitoring techniques for biological control of *Eichhornia crassipes*

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Chapter 1 Introduction

Water hyacinth is widely recognised as the world's worst aquatic weed. Originally exported from its native Amazonia because of its attractive flowers, the species rapidly established and spread throughout tropical, subtropical and warm temperate regions of the world. Water hyacinth forms dense impenetrable mats across water surfaces, limiting access by man, animals and machinery. Navigation and fishing are obstructed, and irrigation and drainage systems become blocked. The consequences are devastating for those communities reliant on water bodies for water, food, sanitation and transport. Programs to control its growth have been initiated in most countries where it occurs.

Photo: M. Julien

Water hyacinth: the world's worst aquatic weed

Photo: M. Julien

Water hyacinth at Port Bell, Uganda

Chemical and mechanical control measures have been used since the early 1900s to combat water hyacinth, but are expensive and ineffective on all but small infestations. Eradication of the weed has been rare because of its rapid growth rate and its ability to reinfest from seeds or isolated plants. Increasing concern about the financial and environmental costs associated with herbicidal control measures and their limited effectiveness has led to growing interest in the use of biological control. Host-specific biological control agents have been identified and researched since the 1960s.

Biological control of water hyacinth offers sustainable, environmentally-friendly, long-term control, and is the only feasible method to provide some level of control to those infestations which cover huge areas, are

Lush growth in a nutrient-rich pond—Papua New Guinea

difficult to access and/or do not warrant the high cost of physical or chemical control. Several biological control agents have now been introduced into countries having problems with water hyacinth. The species most widely used are the *Neochetina* weevils, *N. bruchi* and *N. eichhorniae*. These have been introduced in more than 30 countries and are contributing to weed control in many areas.

These thoroughly researched, proven biological control agents are readily available for introduction into countries where water hyacinth is a problem. As so much research has already been done, these and other control agents can be introduced into new regions comparatively cheaply. The prospects are excellent for successful and sustainable long-term control of water hyacinth in many situations.

Some definitions

Biological control: The use of natural enemies of a weed or pest to suppress populations of the weed or pest.

Natural enemies: Organisms that attack another organism in its native range and thus contribute to the maintenance of population levels.

Classical biological control of weeds: The use of target-specific natural enemies of a weed to suppress populations of the weed in its exotic range.

Biological control agents: Natural enemies (usually insects but also mites, fungi, nematodes, fish) that have been released to control a weed. They have normally undergone studies to determine the range of plant species that they are capable of damaging and are only released if they do not pose a threat to other organisms.

[Definitions adapted from DeBach (1964), Hokkanen (1985), Huffacker and Messenger (1976), and Waage and Greathead (1988)].

Chapter 2
Water Hyacinth

2.1 Description

Water hyacinth, *Eichhornia crassipes* (Martius) Solms-Laubach, is a perennial, herbaceous, aquatic plant of the family Pontederiaceae. The genus *Eichhornia* contains a number of other species all of which are aquatic, but only *E. crassipes* has become a serious weed. The leaves of water hyacinth are comprised of a smooth, glossy, circular to kidney-shaped **lamina** and a swollen, spongy **petiole** (Figure 1). The petioles contain air, causing plants to float on the water surface. This characteristic distinguishes water hyacinth from other members of the family Pontederiaceae which remain firmly rooted in the substrate. **Stolons** grow horizontally to produce **daughter plants** from terminal buds. The bisexual **flowers** are bluish purple with a yellow centre and are produced on single **spikes** to 60 cm in length. The flowers can self-fertilise. The **roots** are long, fibrous and feather-like, and are often dark in colour (Harley 1990; Parsons and Cuthbertson 1992; Wright and Purcell 1995).

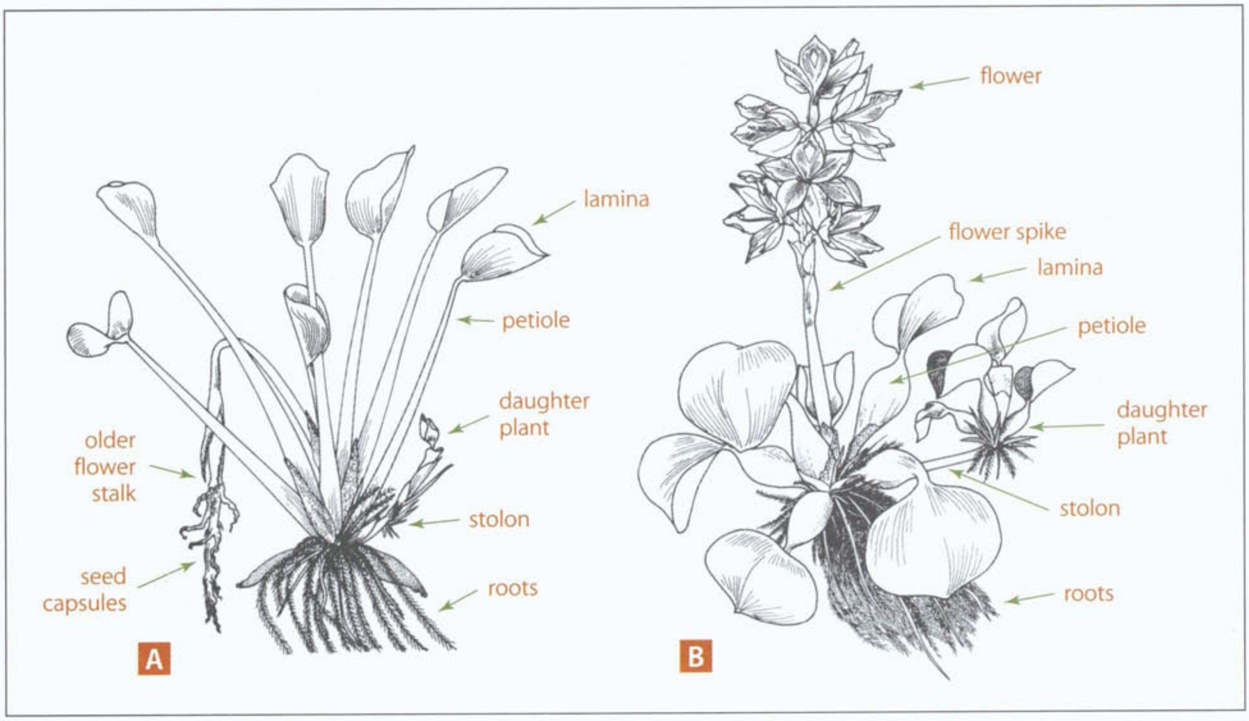

Figure 1. Water hyacinth plants with (A) slender petioles and (B) bulbous petioles (from Wright and Purcell 1995)

Water hyacinth shows considerable variation in both leaf and flower form. The petioles vary from long and slender to swollen or bulbous. The shape of the petiole influences the amount of air contained and consequently the capacity for the plant to float. More slender petioles are typical of plants which occur within dense, crowded infestations, while more bulbous petioles characterise plants in open water or on the open-water margins of infestations. Flowers are of three distinct types, differing in the lengths of the styles and stamen (Barrett 1977). In the introduced range of the species the form with a style of intermediate length predominates, the long-styled form occurs less frequently and the short-styled form has not been recorded (Barrett and Forno 1982). Seeds are produced in large quantities, up to 300 per plant (Wright and Purcell 1995), and are long-lived, remaining viable for 5 to 20 years (Manson and Manson 1958; Matthews 1967; Das 1969;

Photo: M. Julien

Water hyacinth can devastate local communities reliant on waterways for food and transportation—Papua New Guinea

Photo: M. Julien

Offshoot (daughter) plants connected by a stolon to the main (parent) plant

Photo: M. Julien

Water hyacinth limits access to open water—Lake Victoria, Kenya

Photo: A. Wright

Extensive mats of water hyacinth hinder shipping—Kisumu Bay, Lake Victoria, Kenya

Matthews et al. 1977). Seeds sink following release from the seed capsule and may subsequently germinate as water levels fluctuate (see Wright and Purcell 1995).

Vegetative reproduction is common and is largely responsible for the rapid increase and spread of water hyacinth into new areas. The daughter plants produced from the horizontal stolons develop roots and eventually separate from the mother plant following decay or breakage of the connecting stolon. These plants are readily distributed by currents, winds, fishing nets and water craft. Under favourable conditions a single plant can develop into a substantial infestation in a very short time.

2.2 Distribution

The centre of origin of water hyacinth is believed to be Amazonia, Brazil, with natural spread throughout Brazil and to other Central and South American countries (Penfound and Earle 1948; Sculthorpe 1967; Little 1968; Barrett and Forno 1982). The spread of water hyacinth into new areas commenced in the 1880s with its deliberate introduction into the USA as an attractive pond ornamental. Live plants were supposedly handed out to visitors at the 1884 New Orleans Cotton Expo (Center 1994). Thereafter plants continued to be spread around the USA and eventually around the world. Many of these plants were disposed of or spread into ponds and waterways where they rapidly established and continued to expand their range.

Photo: M. Julien

Water hyacinth seriously restricts transportation—Sepik River, Papua New Guinea

Photo: M. Julien

Dense water hyacinth blocks access to Nveye Lagoon, Ghana

The spread of water hyacinth has been spectacular and disastrous. The weed was recorded in Egypt, Australia and southern Asia by the 1890s (Gopal and Sharma 1981), China and the Pacific by the early 1900s (Waterhouse and Norris 1987), East Africa by the 1930s (Chikwenhere 1994), West Africa by the 1970s (van Thielen et al. 1994), and is now established throughout tropical and warm-temperate regions of the world from 40°N (Portugal) to 45°S (New Zealand) (Holm et al. 1977; Julien et al. 1996) (Figure 2). Particularly extensive infestations developed in the southern USA, Mexico, Panama, much of Africa, the Indian sub-continent, Southeast Asia, Indonesia, Australia and the Pacific.