Ongoing Activities in the Biological Control of Water Hyacinth in Egypt

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Abstract

As in many other tropical and subtropical countries, the aquatic floating weed water hyacinth causes serious problems to various types of water bodies in Egypt. The total infested area is estimated to be 487 km^2 covering most of the drainage and irrigation canals in different governorates of Egypt, and about 151 km^2 covering lakes. The total amount of water loss by evapotranspiration from water hyacinth infested areas was estimated to be 3.5 billion m^3 per year. This amount is sufficient to irrigate about a further 432 km^2 every year.

During the period 1978 to 1984, two weevils, *Neochetina eichhorniae* Warner and *N. bruchi* Hustache, were introduced into Egypt and studied under quarantine conditions. Host-specificity tests proved the safety of both weevils for release as biocontrol agents for water hyacinth. No authorisation for release was given until 1999, when a biological control program to be financed by the French Government was approved. In May 2000, 3004 weevils—1118 *N. eichhorniae* and 1886 *N. bruchi*—were collected from water hyacinth infested sites in Fort Lauderdale, Florida, and transferred to Egypt for rearing and multiplication in an aquatic weed greenhouse. Field releases of both species in Egypt began in August 2000.

WATER hyacinth, *Eichhornia crassippes* (Mart.) Solms (Pontederiaceae), was first recorded in Egypt by Simpson (1932). During the period 1978–1984, in cooperation with the United States Department of Agriculture, Fort Lauderdale, Florida, two weevil species, *Neochetina eichhorniae* Warner and *N. bruchi* Hustache, were introduced into Egypt and studied under quarantine conditions through a PL480 project. These beneficial weevils have been introduced and released in several countries in the world (Julien and Griffiths 1998), such as the USA (Perkins 1973; Center 1982), Australia (Wright 1979) and Sudan (Besher and Bennett 1985), to control water hyacinth. Host-specificity tests proved the safety of both weevils for release as biocontrol agents (Julien et al. 1999; DeLoach 1976; Fayad 1982, 1999). No authorisation for release in Egypt was given until 1999 when the Egyptian Ministry of Agriculture approved the introduction of the two *Neochetina* weevils for release on water hyacinth. A biological control program, financed by the French Government, started in January 1999.

In May 2000, 3004 weevils—1118 *N. eichhorniae* and 1886 *N. bruchi*—were collected from water hyacinth near Fort Lauderdale, Florida, USA. They were transferred to Egypt for rearing, multiplication and release in the northern lakes Mariout (Alexandria Governorate) and Edko (Beheira Governorate).

Methods

Construction of aquatic weed greenhouse and growing of water hyacinth

A light and temperature-controlled aquatic weed greenhouse of dimensions 15 × 7 m, containing 9 cir-

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cular water pools of 160 cm diameter and 100 cm depth each, were constructed in the Department of Biological Control, ARC at Giza. Water supply and drainage was provided to each pool. The greenhouse was quarantine secure and supplemented with a dressing room, bathroom and laboratory. The pools were filled with tap water to 80 cm depth and left for 3 days to remove any undesired dissolved gases before introducing water hyacinth plants collected from the River Nile or irrigation canals. Water hyacinth plants were washed thoroughly with tap water before placement in the pools.

Fifteen grams of a soluble NPK fertilizer containing micro nutrients (Polyfeed – Haifa Chemicals Ltd) plus 70 g nitrogen and 10 g iron, were added to each pool monthly or as required, as indicated by leaves turning yellow or a blue colour appearing on the roots. The temperature in the greenhouse was set at an average of about 27.8°C. Plants were washed daily using tap water to prevent aphid and mite infestations. Water was added to the pools whenever needed.

Collecting *Neochetina bruchi* and *N. eichhorniae* for introduction into Egypt

A collecting trip was made to Fort Lauderdale, Florida, USA, during the period 14–19 May 2000. Individuals of both *Neochetina bruchi* and *N. eichhorniae* were collected by handpicking from water hyacinth plants either from the shore or a boat. Collected weevils were kept in plastic containers provided with tissue paper and water hyacinth leaves. The containers were transferred to the laboratory, weevils separated into species and stored in the refrigerator at 10°C. Over 5 days, a total of 3004 weevils of both *Neochetina* species was collected. Samples from the collected weevils were taken, dissected and microscopically examined for insect-disease detection. Weevils were placed in screw-capped carton tubes for shipping, 200–300 weevils per tube. The tubes were stored in the laboratory at 18°C for 2 days then hand-carried to Egypt. Upon arrival, insects were inspected by quarantine officers at Cairo Airport then transferred to the quarantine room attached to the aquatic weed greenhouse and stored in a refrigerator at 10°C. The following day, the insects were examined and healthy weevils were placed on healthy water hyacinth plants placed in the 9 water pools in the greenhouse.

N. bruchi adults were released on water hyacinth in 6 pools, while *N. eichhorniae* were released in the other 3 pools. Each pool was allocated 200–250 weevils. The rest of the weevils were stored in the refrigerator at 10°C.

The pools were examined daily for feeding spots and symptoms of weevil activity.

Harvesting the weevils from water hyacinth plants in the greenhouse

The first generation started to emerge in the first week of August 2000. During the daytime, many adults were found on the floor of the greenhouse, driven out of the pools by overpopulation. These adults were collected. Furthermore, a metal ring net of 120 cm diameter was placed on the water hyacinth plants in the pool and pushed down to submerge them. Floating adults were then collected using a medium-size strainer. The weevils collected each day were counted and placed in square, plastic containers furnished with tissue paper and provided with fresh green water hyacinth leaves. A window of about 8×4 cm covered with wire gauze was made in the cover lid for ventilation. The containers were stored in the refrigerator at 10°C until release of the weevils.

Field release of *N. bruchi* and *N. eichhorniae*

Harvested weevils were transferred in an icebox to the release sites at Mariout and Edko lakes. Both lakes were chosen as they were heavily infested with water hyacinth. Airboats, rubber boats and sometimes narrow wooden fishing boats were used for transfer in the lakes. Release details are given in Table 1.

Results

Establishment of the weevils in the greenhouse

Feeding scars and weevil activities including mating and oviposition were observed 2 days after release. The damage to water hyacinth plants became more obvious each day, and new plants were added periodically or whenever needed. Leaf and petiole samples were taken, dissected and examined under the binocular microscope. Weevil eggs could be seen. Three weeks later, root inspection indicated the presence of different instar larvae attached to the plant roots. In late July, cocoons containing pupae were also found, attached to the submerged roots of the plants. In the first week of August, the first generation started to emerge, indicating success in rearing the introduced weevils under greenhouse conditions.

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Release of *N. bruchi* and *N. eichhorniae* in Mariout and Edko lakes

Some 6573 adults of both *Neochetina* species were released in Mariout and Edko lakes (Table 1). Furthermore, water hyacinth plants supporting different *Neochetina* life stages were distributed on water hyacinth infestations at certain sites in the lakes.

Follow up of the establishment of the released weevils

Weekly visits to the release sites in each lake were conducted to determine the establishment and spread of the weevils. Many feeding scars were observed on water hyacinth leaves, suggesting the establishment of *Neochetina* weevils at the release sites in both Mariout and Edko lakes, but more time is needed to confirm this.

Discussion and Conclusion

Despite the studies conducted in Egypt since 1978 on the use of insects for the biological control of water hyacinth with results indicated the safety of releasing both *N. bruchi* and *N. eichhorniae* (Fayad 1982, 1999), no authorisation for release was given until 1999.

The success of rearing both weevils under greenhouse conditions and symptoms of feeding scars gradually increasing after releasing the weevils in both lakes are very promising signs. By introducing and releasing *N. bruchi* and *N. eichhorniae,* the authors announce that, in August 2000, Egypt joined other countries in applying biological control to water hyacinth. In combination with other control methods it is hoped to gain an acceptable level of water hyacinth control that keeps the population under the economic threshold. Several other known biocontrol agents have to be introduced. A search for, and study of, new agents needs to continue.

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Table 1. Releases of *N. bruchi* and *N. eichhorniae* in Mariout and Edko lakes

Date of release	Site of release	No. of released adults		Total	No. of release sites
		N. bruchi	*N. eichhorniae*		
15.8.2000	Edko Lake	1395	692	2087	3
21.8.2000	Mariout	668	332	1000	3
		infested plants distributed			1
30.8.2000	Edko Lake	702	298	1000	3
		infested plants distributed			1
11.9.2000	Mariout	812	490	1302	3
19.9.2000	Edko Lake	787	397	1184	3
		infested plants distributed			2

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