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Introduction of *Neohydronomus affinis* for Biological Control of *Pistia stratiotes* in Zimbabwe

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INTRODUCTION

Water lettuce, *Pistia stratiotes* L., has a cosmopolitan distribution throughout tropical regions of the world (Holm et al. 1977; Sculthorpe 1971) where it causes serious blockages to waterways. In Zimbabwe, water lettuce and waterhyacinth (*Eichhornia crassipes* (Martius) Solms-Laubach) are serious pests in dams and rivers around Harare especially in Lake McIllwaine. which is the main water source for domestic and industrial use in the city. It is not known when water lettuce first appeared in Zimbabwe but it was definitely present in 1950 (Jarvis et al. 1981).

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Between 1985 and 1987 two and a half million Zimbabwean dollars were expended to eradicate water lettuce and waterhyacinth from Lake McIllwaine by mechanical and chemical methods. The herbicide, 2,4-D, was used between 1953 and 1977 (Jarvis et al. 1981) but was discontinued following concern of possible undesirable effects on human and animal life using the water.

Water lettuce has been successfully controlled in Australia, (Harley, et al. 1984, 1990), South Africa (Cilliers 1987), Botswana (P. Smith pers. comm. 1989) and Papua New Guinea by the weevil, *Neohydronomus affinis* Hustache previously referred to as *N. pulchellus* (Thompson and Habeck 1989). In September 1987, a colony of the weevil from Australia was hand carried to Harare where adult feeding was tested against a number of plants important to Zimbabwe. The weevil was subsequently released in the

Manyame River, upstream of Lake McIllwaine. Laboratory experiments were also carried out at the Plant Protection Research Institute, Zimbabwe to test the effect of the weevil on plant growth. The adult feeding tests, effect of the weevil on plant growth and establishment of the weevil in the field are described.

MATERIALS AND METHODS

Laboratory studies. Mature water lettuce plants of similar size, average 12 leaves/plant, were collected from the Upper Manyame River and placed in large containers, 53 cm diameter and 36 cm deep. Twenty-five ml of Groesia ($5N + 6P_2 0_5 + 7K_2 0_5$, Mg 0.1%, Zn 0.03%, Cu 0.02%, B 0.03%) was added per 4.5 litres of water each fortnight and water was replaced in the containers once or twice a month. The plant cultures were kept in a glasshouse where temperatures fluctuated between 25 C and 30 C.

In October 1987, adult weevils were placed in ten containers to give a density of 16 adults/plant. Other containers were kept free of insects to act as controls so that comparisons between plant growth in the two treatments could be made. Before insects were added and every fortnight over a ten month period thereafter, the number of plants in each container, the number of leaves/plant, the length and width of each leaf, and the length of the longest root were recorded. In the insect-free treatment, these measurements were taken from parent plants during the first 3 months and then from daughter plants during the next 5 months. Daughter plants were used after December 1987, as they were more appropriate for comparison with plants in the treatment with insects.

Host specificity studies. Thirty-five plants in 23 families were tested against *N. affinis* in choice and no choice tests carried out in a constant temperature room at 27 C and a relative humidity of about 70%. The aquatic plants, water lettuce, waterhyacinth and parrotfeather, *Myriophyllum aquaticum* (Velloso) Verde, were tested as well as several economically important grain, fibre, fruit and vegetable plant species[3].

In choice tests, five adult weevils were placed in a petri dish with a freshly cut leaf disc, 1.8 cm diameter, from each of three different test plants together with a disc from water lettuce. The discs were replaced daily over a two week period and the number of feeding scars on each disc was recorded daily. This procedure was repeated until each plant had been tested four times.

A similar procedure was used for no choice tests except that no water lettuce was included in the tests. Plant discs were changed and data recorded six times over a two week period after which the test was terminated. This procedure was repeated twice for each test plant.

Field release. On 8 April 1988, 1586 adult *N. affinis* were released over an area of 100 m^2 in the Manyame River. The site was dominated by water lettuce and there was no application of chemicals or mechanical disturbance in this area.

[3]The list of 35 plant species from 23 families tested in these studies is available from the authors.

RESULTS

Feeding tests. In choice tests adults fed only on their host plant, water lettuce (7.1 feeding scars/day) except for one scar on waterhyacinth during 280 insect days. In no-choice tests there was no feeding on any plant species other than water lettuce.

Effect on plant growth. Prior to the introduction of the weevil, parent plants were large with leaves averaging 15 x 8 cm and roots to 50 cm long (Figure 1). After six weeks of feeding damage by the weevil, most parent plants had rotted and sunk to the bottom of the experimental containers leaving only daughter plants. By contrast, parent plants in the containers without insects (controls), grew and produced many daughter plants in the same period. By December the length of the longest root on the weevil infested plants was less than half the length of that in the control, and leaves were shorter though of a similar width to those of the control (Figure 1).

Daughter plants from the weevil-damaged plants failed to grow to the size of normal parent plants and were much smaller than the daugher plants in the insect-free treatment when comparative measurements commenced in January (Figure 1). In the insect-free treatment daughter plants increased in size to resemble the original parent plants whereas plants attacked by the weevil remained small, leaves 8 x 5 cm and roots 3 cm long (longest root < 15 cm). By April, plants supported an average of four adults and there was no significant change in adult density or plant size until July, when the insect-treatment was terminated. Figure 1 shows the changes in plant growth in the two treatments until end of May, when the insect-free treatment was terminated.

Field Observations. The weevil was well established in the Manyame River by July 1988, 4 months after the first re-

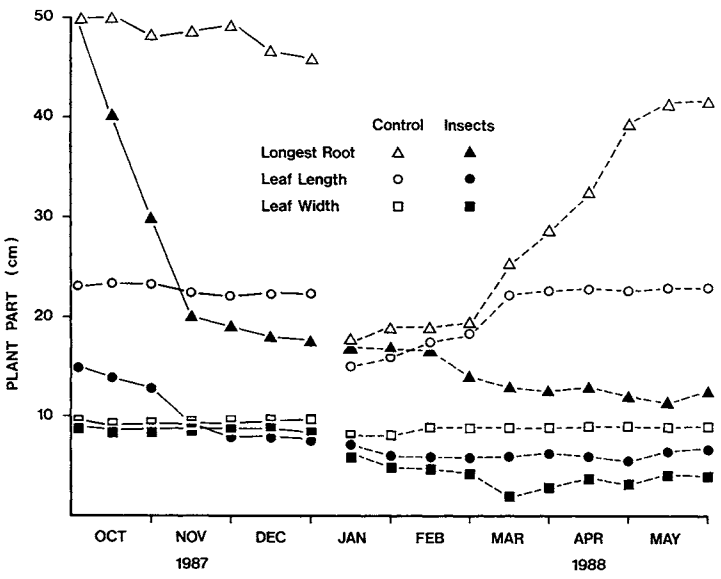

Figure 1. Effect of *Neohydronomus affinis* on growth of water lettuce in the laboratory. The solid lines (————) indicate data collected from parant plants and the dashed lines (— — — — —) data from daughter plants.

lease. Many plants were severely damaged, plant size was declining and other aquatic plants, namely waterhyacinth and parrotfeather had begun to invade the area. By October 1988, the weevil was breeding throughout a region, 9 kilometres upstream and 5 kilometres downstream, from the release site. Population density averaged 5.6 adults/plant and many plants were decaying due to larval attack. By February 1989, less than 12 months after the release of *N. affinis*, water lettuce was no longer a problem in the Manyame River.

DISCUSSION

N. affinis has reduced large areas of water lettuce in Zimbabwe to very small infestations. In this laboratory study, the greatest effect on plant growth was a reduction in plant size which supports the results of field trials in Australia by Harley et al. (1984, 1990). Biological control agents generally take 3 to 5 years to reduce weed growth. However, *N. affinis* has brought about spectacular control of water lettuce in as little as one to 2 years.

The problems posed by water lettuce are often localized and not as widespread and costly as those of waterhyacinth and salvinia, (*Salvinia molesta* Mitchell). In Australia, biological control was implemented against all actual and potental floating aquatic weeds to minimise the possibility of one problem floating weed being replaced by another as control of one was achieved. Application of this strategy brought about successful control of waterhyacinth, salvinia and water lettuce in most areas of Australia. Zimbabwe has adopted a similar strategy and is currently testing waterhyacinth weevils for biological control of waterhyacinth, which is still a major problem in the Manyame River.

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