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INTRODUCTION OF THE WATERHYACINTH WEEVIL (*Neochetina Eichhorniae* WARNER) INTO PUERTO RICO

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San Juan, Puerto Rico 00906

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The waterhyacinth weevil *Neochetina eichhorniae* Warner was introduced into quarantine in Puerto Rico in anticipation of future release of the insect to aid in the control of its host aquatic plant *Eichhornia crassipes* (Mart.) Solms. The insect is being tested for host specificity by subjecting many native plant species to it; these species include many which are of particular ecological or economic significance in Puerto Rico. Although the results are preliminary, this insect species appears to be host specific to waterhyacinth as it proved to be in the continental United States.

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Preface

This report presents results of a project on biological control of waterhyacinth being conducted for the Aquatic Plant Control Research Program (APCRP) by the Department of Natural Resources, Commonwealth of Puerto Rico, San Juan, Puerto Rico, under Contract No. DACW39-78-M-2487. The purpose of this project is to evaluate the waterhyacinth weevil *Neochetina eichhorniae* for control of waterhyacinth in Puerto Rico. Funds for this effort are provided by the Office, Chief of Engineers, under appropriation number 96X3122, Construction General, through the APCRP at the U. S. Army Engineer Waterways Experiment Station (WES).

The principal investigator for the work was Dr. Leonce Bonnefil who prepared this report. He was assisted in the work by Messrs. Miguel A. Rodríguez, Evangelio Lebrón, and Eduardo de Aragón.

The work was monitored at WES by Mr. W. N. Rushing of the Aquatic Plant Research Branch (APRB), under the general supervision of Mr. W. G. Shockley, Chief of Mobility and Environmental Systems Laboratory (MESL), and Mr. B. O. Benn, Chief of the Environmental Systems Division, and under the direct supervision of Mr. J. L. Decell, Chief of the APRB. As a result of a reorganization at WES, Mr. Decell is now manager of the APCRP, which is a part of the Environmental Laboratory of which Dr. John Harrison is Chief.

The Commander and Director of WES during this period was COL John L. Cannon, CE. Technical Director was Mr. F. R. Brown

Contents

Conversion Factors, U. S. Customary to Metric (SI)
Units of Measurement

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
inches	25.4	millimetres

INTRODUCTION OF THE WATERHYACINTH WEEVIL (*Neochetina Eichhorniae* WARNER) INTO PUERTO RICO

Background

1. Practically all water bodies in Puerto Rico are infested to some degree with aquatic weeds. The reasons of this high incidence of the pest plants can be found in the topographical, hydrological, as well as the socioeconomical conditions of the island.

2. Puerto Rico is small, mountainous, and densely populated. The high amount of rainfall, especially on the north coast, sustains a number of rather important streams among which are Rió La Plata, Rió Grande de Manatí, Rió Grande de Arecibo, Rió Espiritu Santo, and Rió Grande de Loíza. All of these streams receive great quantities of nutrients from agriculture lands, pastures, milking stands, and a great variety of industries. They are highly eutrophic since they are short and slow moving in the coastal plain, allowing for little to no dilution of contaminants. Most of these rivers are also dammed and the resulting reservoirs are all invaded to a certain extent by water weeds.

3. In the rainy season flash floods are customary, causing the weeds from headwaters and reservoirs to be washed downstream producing accumulations at dams, bridges, and natural or artificial obstructions.

4. There always are residual stands of waterhyacinth along the sinuous courses of rivers and within coves in natural and artificial ponds or lakes. These stands, in addition to being sheltered from rushing waters, are often at the foot of steep hills and are the nurseries of waterhyacinth, alligatorweed, waterlettuce, duckweed, and other less important floating aquatics. Rooted species like paragrass help in anchoring down the vegetable mass. The destruction of the plants in these protected recesses is neither easy nor cheap.

5. In general, conventional methods of weed control by machines and chemicals are of limited use in Puerto Rico, the streams being shallow, rocky, and, as mentioned earlier, offering little chance for mixing and dilution of chemical residues.

6. The only alternative which is safe, self-renovating, and inexpensive, once successfully established, is biological control. For that reason, the introduction of the waterhyacinth weevil in Puerto Rico was projected at the beginning of 1977 with the financial assistance of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi.

Introduction of the Insect

7. Following conversation and correspondence with Dr. David Perkins of the U. S. Department of Agriculture (USDA) Fort Lauderdale, Florida, as to the biology and ecology of *Neochetina* and after a request for introduction was processed through local and Federal channels, the first group of weevils was mailed and arrived on 1 February 1977. Of those mailed 386 were alive and 3 were dead.

8. Previously, two large glass tanks 2 by 2 by 6 ft* had been made available in a Department of Natural Resources laboratory in San Juan and stocked with waterhyacinth plants. There was an excess of insects (eight per plant), but the tanks were meant as temporary storage and as a source of insects for tests of food preference with local species of plants.

9. As anticipated, the plants did not resist and never lasted over an average of four days. The laboratory was kept at about 25°C and 62 percent relative humidity.

10. It became apparent that a large number of plants would be necessary to replace the dying ones. It was then decided to construct a screenhouse in which large wooden troughs, waterproofed with fiberglass, would be maintained to supply waterhyacinth as well as test plants. Such a structure was set up on top of a building next to the air-conditioned laboratory. The screenhouse was meant to keep foreign insects away from the waterhyacinth cultures while they were under natural

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* A table of factors for converting U. S. customary units of measurement to metric (SI) can be found on page 3.

light. The results were satisfactory except in times of stormy weather when the winds blew salt spray that burned the plants (the Department of Natural Resources building is close to the beach).

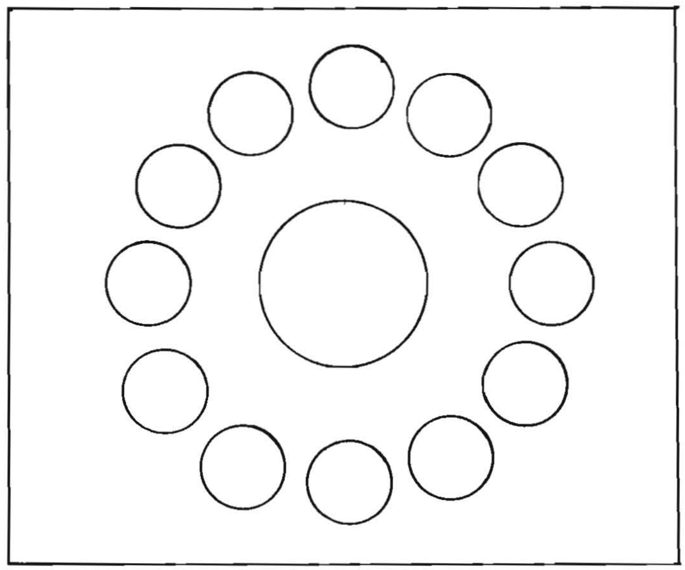
Host Preference Tests

11. The tests of host preference were performed using the layout of Figure 1. A simple cage 48 in. long, 48 in. wide, and 30 in. high with an elevated bottom was used. Twelve empty cans were distributed in a circle around a center hole for a glass bowl which contained a waterhyacinth plant. The 12 cans contained four plant species each one being replicated three times. The positions of the replicates was determined by the use of random tables, each plant being assigned a number. The center waterhyacinth plant had several healthy leaves. A small cage was placed over the waterhyacinth plant to confine the weevils until they became familiarized with the cage environment. The insects were then freed by removing the cage. The leaves of the test plants were examined daily for 2 weeks for signs of feeding by the weevils. All plants were then removed from the test cage and incinerated. The soil was fumigated with carbon tetrachloride to kill all possible insect stages.

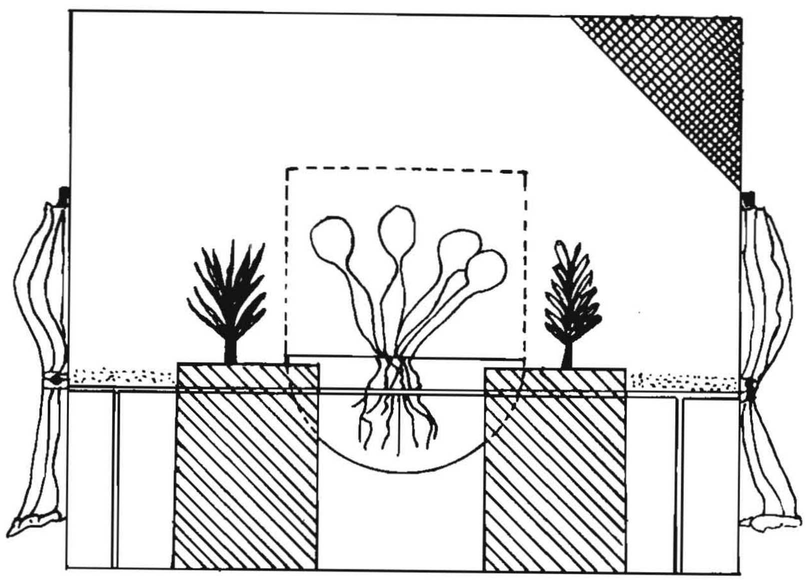
12. Three tests were performed at the dates stated below using plants found in close association with waterhyacinth, being either truly aquatic, submerged, attached to the bank, projecting over water, or grown close to river courses, lakes, or ponds.

a. Test I (4 February 1977):
Lettuce (*Lactuca sativa* L.)
Cabbage (*Brassica oleracea* L.)
Tomato (*Lycopersicum lycopersicum* L.)
Smartweed (*Polygonum portoricensis*)

b. Test II (21 May 1977):
Eggplant (*Solanum melongena* L.)
Corn (*Zea mays* L.)
Sweet potato (*Ipomea batatas* L.)



a. Cans are arranged clockwise around the waterhyacinth bowl



b. Section showing how cans fit into false bottom

Figure 1. Cage for feeding tests

Alligatorweed (*Althernanthera philoxeroides* (Mart.) Griesb.)

c. Test III (20 February 1978)

Wild castor bean (*Ricinus communis* L.)

Water lettuce (*Pistia stratioties* L.)

Pepper (*Capsicum annum* L.)

Cutleaf nightshade (*Solanum torvum* Sw.)

13. As a rule, plant species that were tested in other countries against *Neochetina* were not preferentially included in these tests.

14. Different concentrations of weevils were used. No criterion for the number of insects was available and arbitrary numbers of weevils were provided per test plant from a minimum of 2 to a maximum of 4. In all cases, the number of insects on the waterhyacinth greatly overran the plant and it quickly dried up. Nevertheless, no insect was ever found probing or feeding on any plant except the waterhyacinth.

15. To get away from the adverse effect of salt spray, space was secured in a glass greenhouse at the Agriculture Experimental Station in Rió Piedras (Figures 2 and 3). Already available were cement troughs divided in sections 40 in. long, 37 in. wide, and 16 in. high. Over these troughs, screened cages 3 ft tall and opening at the top were built (Figures 4 and 5).

16. Using the insects left from a second shipment on 1 September 1977, 150 specimens were introduced at the rate of two insects per plant in the five sections of one of the troughs. See Figures 6 and 7 for comparison.

17. At first the waterhyacinth grew normally and showed no sign of stress. Later, however, as the plants had been in the troughs for about 3 months, signs of mineral deficiencies appeared, mostly of iron and manganese, and had to be corrected. The weevils began feeding promptly. Weekly counts were made of the feeding spots and later, as it became evident that the growth of the plants was stressed by the feeding of the insect, measurements were also made of the central wrapping leaf and the other leaves around the crown.

18. At the time of the writing of this report there was no evidence that the weevils were reproducing in captivity. There was an

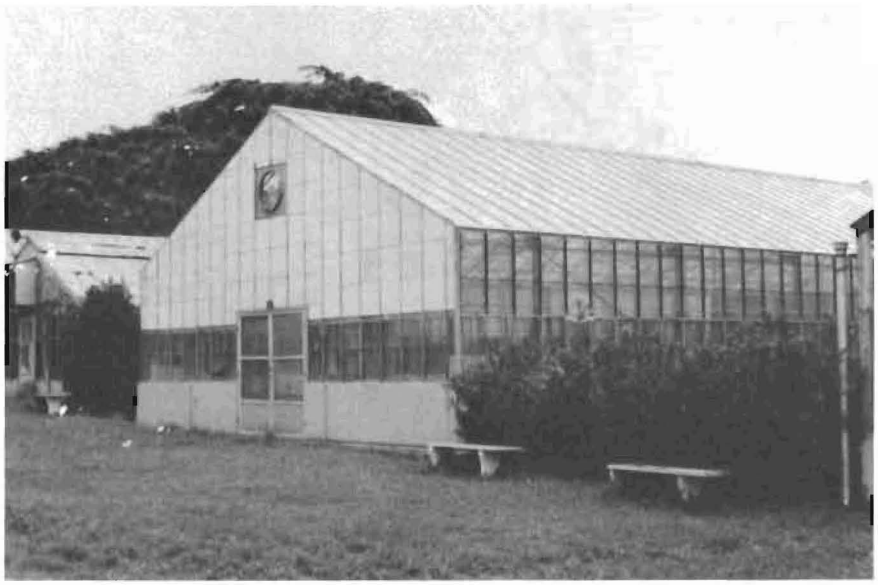


Figure 2. Greenhouse at the Agricultural Experiment Station in Rió Piedras, Puerto Rico, within which *Neochetina* population was kept

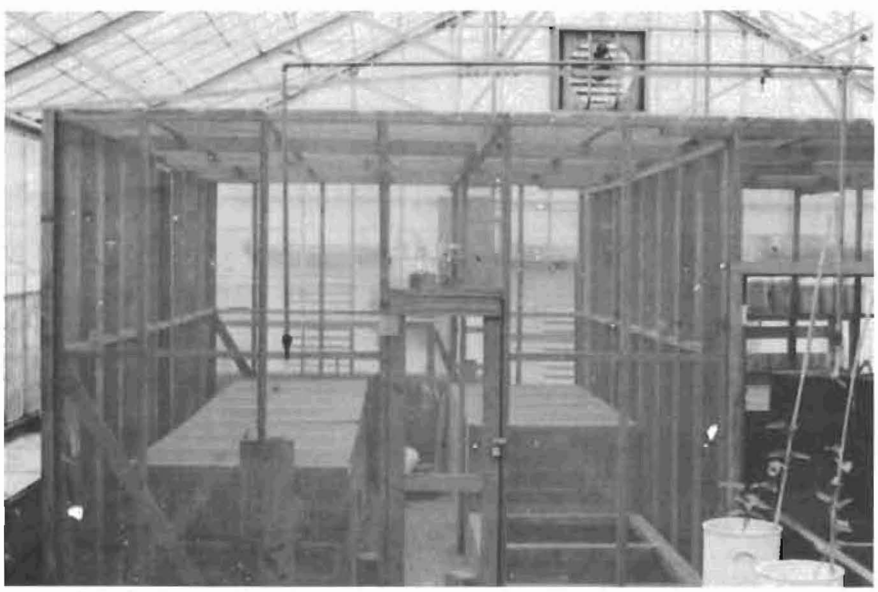


Figure 3. Section of the greenhouse restricted for research with the waterhyacinth weevil

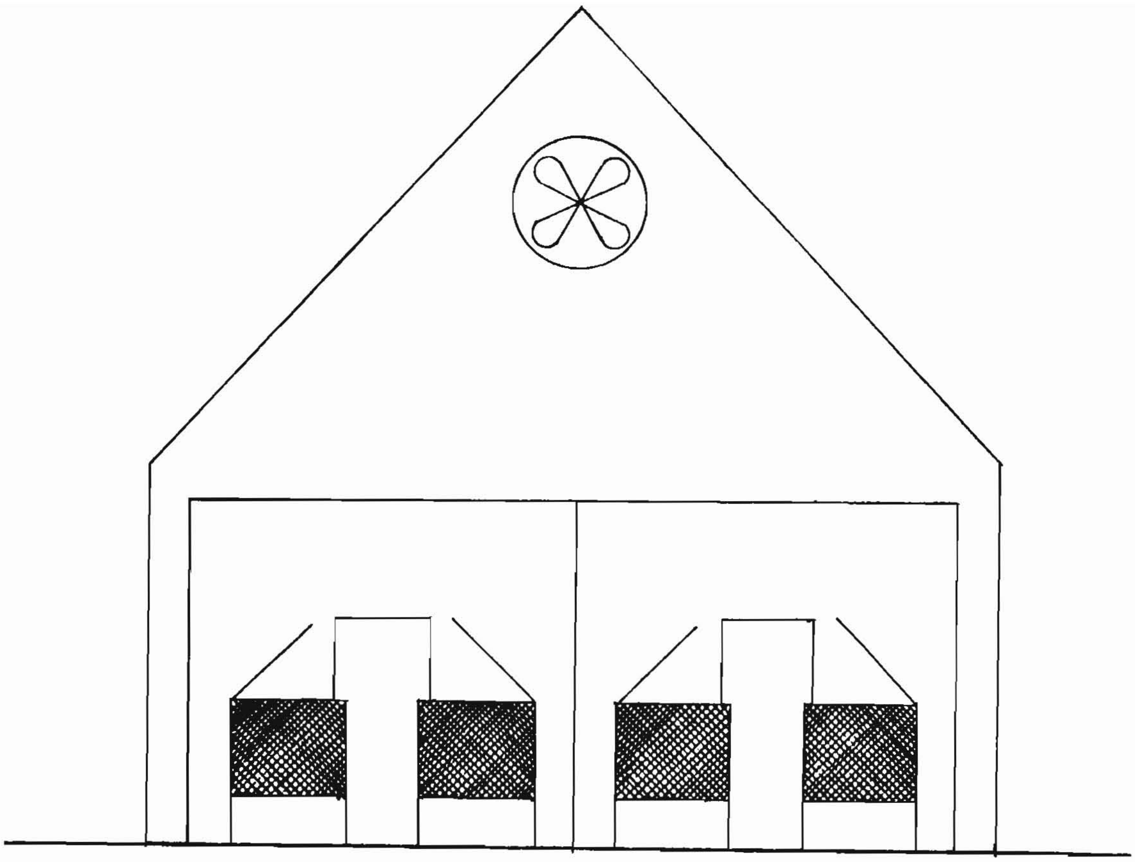


Figure 4. System of screened cages for rearing *Neochetina* under quarantine in San Juan, Puerto Rico

apparent general decline in the number of feeding spots and a certain degree of recovery of the damaged plants. A simple experiment was also performed to determine the presence of a population of weevils supposed then to be higher than two individuals per plant, in the following manner. Three plants from the control, without any weevil damage, were introduced among the damaged plants in two sections and closely observed. The attack on the plants was fair but obviously not enough to critically affect them. To accurately assess reproduction, it would be necessary to go into egg and larvae counting.

19. The declining damage level might have been the result of a variety of factors, among which are plant age, insect age, conditions within the glasshouse (mostly temperature), etc. If proved necessary,

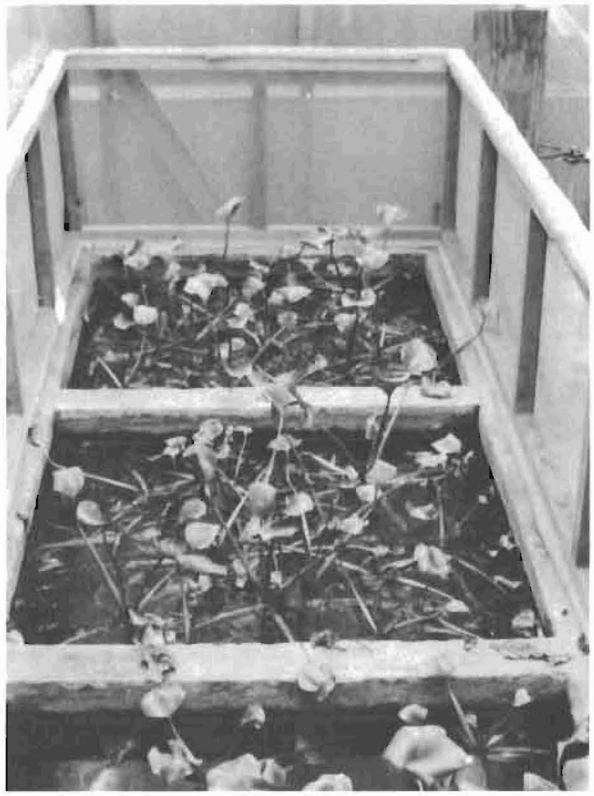


Figure 5. Closeup view of cement trough with *Neochetina* infested waterhyacinth

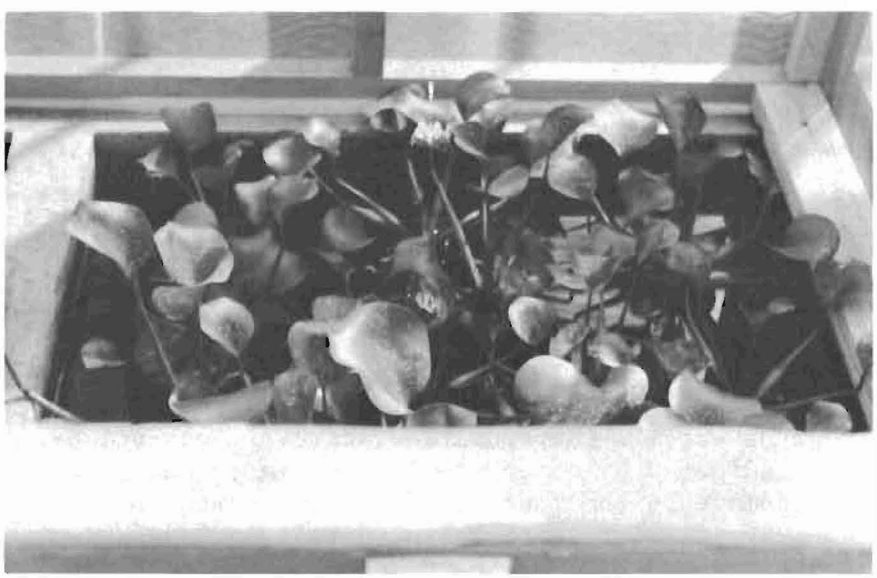


Figure 6. Section of trough with waterhyacinth showing *Neochetina* damage

Figure 7. Control without weevils. At a later stage the hyacinth grew to considerable size

these aspects might be investigated at a later stage since such information could be of value in the future.

Summary and Comments

20. The following summary is offered:

    a. The first waterhyacinth weevils (*Neochetina eichhorniae* Warner), which were introduced in Puerto Rico and maintained in strict quarantine, survived 212 days or roughly 7 months.

    b. They did not multiply in the laboratory although they did lay eggs which developed into larvae, obviously because the plant host was under artificial light and died fast and had to be constantly replaced.

    c. Under natural light, the waterhyacinth survived well (now 9 months) and was significantly stressed by the attack of the weevil. Reproduction, however, was not evident, as indicated by a decline in the degree and severity of the damage by the insect. It is suspected that treated water may interfere with larval development and/or pupation.

    d. Research in conditions of quarantine cannot be said to fully represent the conditions of nature and at this stage some release in isolated sites should be considered. These sites should be closely monitored.

e. Concurrently, bionomic studies should continue under relaxed quarantine conditions to establish different aspects of the dynamics of *Neochetina* populations. It may be necessary to move the insect out of the glass greenhouse to a screenhouse which would be cooler.

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