ISSN:
Print - 2277 - 0593
Online - 2315 - 7461

Journal of Natural Sciences, Engineering and Technology

SINGLE-PLANT STARVATION AND PAIRED-PLANT STARVATION TESTS OF ADULT *Neochetina eichhorniae* WARNER

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ABSTRACT

Single-plant starvation and paired-plant starvation tests were performed on adult *Neochetina eichhorniae* to determine the feeding specificity of the insect on the following plants: *Eichhornia crassipes, Pistia stratiotes, Hymphaea lotus, Ceratopteris sp, Azolla species, Colocasia esculentus, Vigna sinensis, Talium triangulare, Capsicum annum* and *Lycopesicom esculentus.*The feeding spots of *N. eichhorniae* on the different plants were assessed and counted using a hand-counter. *N. eichhorniae* adults fed on *E. crassipes only,* confirming the feeding specificity of the *N. eichhorniae* to *E. crassipes* and the safety of other plants growing in the habitat.

Key words: Single-Plant, Paired-Plant, Starvation, Arthropod, Water-Hyacinth and Specificity

INTRODUCTION

The Need for the Control of the Water Hyacinth

In virtually all areas where water hyacinth occurs as an aggressive alien element in fresh-water ponds, reservoirs, waterways and others, the plant causes a number of problems to man. Dense and large masses of the weed impede the flow of water in irrigation systems, prevent the free movement of boats and other navigation vessels, reduce the volume of available fresh water by increasing losses through evapotranspiration, and compete with agricultural crops in cultivated areas. Also, the water hyacinth impair the quality of water, cause serious disruption to other aquatic life including fish and plankton, provide suitable habitat or food or both for molluscan and insect vectors of diseases like schisotomiasis and malaria, promote silting and gradual drying up of stagnant water bodies, and serve as alternative hosts of destructive organisms like crop pests and pathogens. Biological control of *E. crassipes* was first given serious attention in the United States in the 1960's. At that time, a snail (*Marisa* sp) and the West Indian Manatee (*Trichechus manatus*) were even considered as possible biological control agents. In 1968, Perkins of the U. S. Department of Agriculture was assigned the task of determining if there were any insects on *E. crassipes* in its native range that might be useful as biological control agents. This led to concerted efforts on the biological control of *E. crassipes.*

The water hyacinth is extremely tolerant of,

and has a high capacity for, the uptake of heavy metals, including Cd, Cr, Co, Ni, Pb and Hg, which could make it suitable for the bio cleaning of industrial waste water (Upadhyay, Alka. R, and B. D. Tripathi, 2007), (Abou-shanab, R. A. I. *et al.*, 2007), (Maine, M. A. *et al.*, 2006)and (Skinner, Kathleen *et al.*, 2007). In addition to heavy metals, *E. crassipes* can also remove other toxins, such as cyanide, which is environmentally beneficial in areas that have endured gold mining operation (Ebel, Mathias *et al.*, 2007).

Water hyacinth removes arsenic from arsenic contaminated drinking water. It may be a useful tool in removing arsenic from tube well water in Bangladesh (Misbahuddin, M and Fariduddin, A. T. M, 2002).

Water hyacinth is also observed to enhance nitrification in waste water treatment cells of living technology. Their root zones are superb micro-sites for bacterial communities (J. Todd and B. Josephson, 1996).

Perkins (1973a, 1974) found that *Neochetina eichhorniae* did not attack beneficial plants and he subsequently introduced it into the United States (Perkins 1973b); he made early observations of the biology of *N. eichhorniae* and of *N. bruchi*. Deloach (1976) and Perkins and Maddox (1976) tested the host specificity of *N. bruchi* and found that it was safe as a biological control agent.

The objective of this work is to determine the feeding specificity of *Neochetina eichhorniae* on water hyacinth thereby confirming its biological control in the ecosystem.

MATERIALS AND METHODS

Single-Plants Starvation Test

The tested plants were plant species closely related to the natural host, *Eichhornia crassipes* and those growing in the same habitat: *Eichhornia crassipes* (water hyacinth), *Pistia stratiotes* (water lettuce), *Nymphaea lotus* (water lily), *Ceraptoteris sp., Azolla sp., Colocasia esculentus* (cocoyam), *Vigna sinensis* (cowpea), *Talium triangulare* (water leaf), *Capsicum annum* (pepper) and *Lycopersicom esculentus* (tomato).

In single-plant starvation test, the weevils had no choice of host plant. Twenty adults of *Neochetina eichhorniae* were released on each of the tested plants. A new plant was introduced each day for 5 days. The feeding spots on the different parts of the shoot system, where applicable, such as the petiole or stem, upper leaf surfaces were assessed and counted using a hand counter.

The Paired-Plants Starvation Test

In this experiment, the feeding rate of *Neochetina eichhorniae* on *Eichhorniae crassipes* (water hyacinth) was compared with those of *Pistia stratiotes* (water lettuce), *N. lotus (water lily), Ceratopteris spp, Azolla sp, C. esculentus* (cocoyam). This was done by placing water hyacinth alongside with each of the other plants in a cage. Twenty adults of *N. eichhorniae* were released on each set-up. New plants were introduced each day for 5 days. The feeding spots of *N. eichhorniae* on the paired-plants were assessed and counted using a hand-counter.

RESULTS

Feeding Pattern of Neochetina eichhorniae on Test Plants

Single-Plant Starvation Test

In this test, adult *Neochetina eichhorniae* had no choice of test plant. Feeding was only on *Eichhornia crassipes* plants. (Plates 1 & 2).

Paired-Plant Test of Feeding

The weevils produced fifty to one hundred feeding spots per leaf on *E. crassipes* (water hyacinth) in each treatment during the 5 days test period. No feeding spots were observed on any of the other nine(9) test plants.

Plate 1: Feeding spot of *Neochetina eichhorniae* on Petiole of water hyacinth

Plate 2: Feeding spot of upper and dorsal leaf surfaces caused by *Neochetina eichhorniae* on water hyacinth

DISCUSSION

Feeding and Host-Specificity Tests

In this study, results of single-plant starvation test and paired test showed that adults of *N. eichhorniae* fed only on water hyacinth. This fact was evidenced by the feeding-spots found on the leaves and petioles of water hyacinth. Also in larval feeding test, the larvae of *N. eichhorniae* developed well into pupae only on water hyacinth. (Plate 3). Del Fosse and Perkins (1977) reported the occurrence of a Kairosome (chemical messenger) in the water hyacinth which attracts and concentrates water hyacinth weevils and mites around the feeding sites. The release of Kairosome by the plants strengthens the host-specificity of these arthropods.

De Loach (1975) noted that *N. eichhorniae* feeding is host specific to plant family Pontederiacea and is able to complete its life-cycle on water hyacinth only. This adaptation of *N. eichhorniae* ensures the safety of other economic plants and crops. The results of the present study agree with those of previous notable workers.

Plate 3: Formation of pupal of *Neochetina eichhorniae* on the root of water hyacinth

SUMMARY AND CONCLUSION

The result of this study revealed that the adults of *N. echhorniae* aggregated on the rhizome and root regions of water hyacinth because these parts of the plant are always in contact with water which is the only medium in which *N. echhorniae* can survive. The aggregation of *N. echhorniae* around the base of the plant and their feeding actively on this part of the plant was noted. The damage caused to water hyacinth by the adults of *N. eichhorniae* is very instinctive and conspicuous. As they feed they move their snout across the surface scraping off a line of epidermis with their mandibles.

While feeding, they remain stationary and move their head from side to side thus limiting the rotational ability of their head. As they finish one line they move slightly and begin another parallel to the first.

They continue feeding this fashion until a small rectangular area of epidermis is removed leaving a very distinctive lesion or feeding scar. These scars vary in length depending upon the time spent feeding, but usually increase with feeding time.

The side to side feeding behavior often leaves a characteristics pattern of parallel ridges apparent within the scar.

Feeding occurs primarily on the lamina of the leaf and the *N. eichhorniae*adult prefer the youngest leaves at the base of waterhyacinth.

As the larvae burrowed within the petioles, a great deal of damage to the plant occurred. The feeding galleries often become water-logged and necrotic and they were evident as long, brown lines visible on the outside of the petiole. When several of these galleries converge at the petiole base, the extensive damage to the vascular tissues caused the leaf to wilt. In extreme cases, the petiole breaks or rots through and it is completely severed from the stem. In less extreme cases, the larval gallery collapses causing a sunken line of scar-like tissue. As the larvae mature and enter the stem, the damage caused is relatively superficial.
However, when many larvae are present, this damage becomes substantial and causes the stem to fragment and the shoot to fall apart. Also, when large numbers are present, the chance of one reaching the apical bud increases. Since this is the growing point of the shoot, if it is destroyed the shoot dies. The most significant aspect of the entry of the larvae into the stem was the accompanying entry of microbial organisms. These cause the stem to soften and rot, forming an associated black coloration of the tissues.

Results of single-plant starvation test and paired-plant test show that adults of *N. eichhorniae* fed only on water hyacinth. This fact was evidence by the feeding-spots or feeding scars found on the leaves and petioles of water hyacinth.

Laboratory experiment has shown that *Neochetinaeichhorniae* is an excellent candidate for biological control of water hyacinth. It has sufficient merit as a bio-control agent for such levels of water hyacinth infestation found today in the Nigerian aquatic biotopes: rivers, lakes, lagoons and creeks. It is persistence in its bio-control capacity, specifically for water hyacinth. It should therefore be employed anywhere there is water hyacinth infestation in the aquatic ecosystem in Nigeria using appropriate specialist, scientific support and/or supervision.

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(Manuscript received: 8th August, 2011; accepted: 27th June, 2012).