*Indian J. Weed Sci.* **39** (1 & 2) : 81-84 (2007)

# Host Preference of *Neochetina bruchi* Hustache and *N. eichhorniae* Warner towards Leaves and their Aqueous Extracts of Chosen Agricultural and Horticultural Crops

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**ABSTRACT**

The water hyacinth weevils, *Neochetina bruchi* Hustache and *Neochetina eichhorniae* Warner were studied for their orientation behaviour towards leaves and their aqueous extracts of 18 agricultural and horticultural crops and the host plant *Eichhornia crassipes* (water hyacinth) under laboratory conditions with the help of a multi-arm olfactometer. Excess proportion index (EPI) was worked out to know the approaching behaviour of the weevils. Both *N. bruchi* and *N. eichhorniae* rejected all the crops tested here and preferred water hyacinth only. The EPI values for the leaves of all the crops tested (except paddy and pomegranate) and their extract treatments were only negative, indicating that the weevils rejected the plants. Positive values were obtained in pomegranate (+0.33) and paddy (+0.11) leaf treatments when *N. bruchi* and *N. eichhorniae* were used, respectively. In general, extracts were more deterrent to both the weevil species than leaf treatment.



## INTRODUCTION

Water hyacinth, *Eichhornia crassipes* (Mart) Solms-Laubach, is a perennial, herbaceous, aquatic plant of the family Pontederiaceae. It is widely recognized as the world's worst aquatic weed. Water hyacinth forms a dense impenetrable mat across the water surface, limiting access by man, animals and machinery. It obstructs navigation and fishing and blocks the irrigation and drainage systems. Programmes to control its growth have been initiated in most countries where it occurs. 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. Efforts to control water hyacinth by biological means have been undertaken earlier by many investigators (Andres and Bennett, 1975; De Loach, 1976; Nagarkatti and Jayanth, 1984; Jayanth and Nagarkatti, 1987). Perkins (1974) reported that more than 70 species of arthropods capable of feeding on water hyacinth are found in different parts of the world

A number of biological control agents have now been introduced into countries, which are facing the menace of water hyacinth. The species most widely used are the water hyacinth weevils, *Neochetina bruchi* and *Neochetina eichhorniae*. The present study has been undertaken to find out the host preference of these weevils for fresh leaves and water extracts of 18 agricultural and horticultural crops that are economically important and grown in the same geographical region as the aquatic habitat of *E. crassipes* using a specially designed multi-arm olfactometer.

## MATERIALS AND METHODS

### Insects

The test insects, *N. bruchi* and *N. eichhorniae* were purchased from the Project Directorate of Biological Control, Indian Council of Agricultural Research (ICAR), Bangalore. The weevils were stocked on water hyacinth plants in plastic tanks (75 x 52 x 52 cm) under laboratory conditions (30 ± 1$^{o}$C; 11 ± 0.5 h photoperiod; 65-75% RH). Every week the water and plants in the stocking tank were replaced by fresh water and plants.

### Preparation of Leaf Extracts

Fresh leaves of 18 plants were used for extract preparation. The plants used for the preparation of water extract were : blackgram (*Vigna mungo*), groundnut (*Arachis hypogaea*), clusterbeans (*Cyamopsis tetragonoloba*), brinjal (*Solanum melongina*), chilli (*Capsicum annum*), tomato (*Lycopersicon esculentum*), bitter gourd (*Minodia charantia*), bottle gourd (*Lagenaria siceraria*), amla (*Phyllanthus emblica*), tapioca (*Manihot ultissima*), mango (*Mangifera indica*), bhendi (*Abelmoschus esculentus*), curry leaves (*Murraya koenigii*), lime (*Citrus medica*), coleus tuber *(Coleus parviflorus)*, guava (*Psidium guajava*), paddy (*Oryza sativa*) and pomegranate (*Punica granatum*). Water extract of water hyacinth (*E. crassipes*) leaves served as control

Ten grams of the leaves of each plant were washed with tap water and ground well separately with 5 ml of distilled water in a mortar and pestle and squeezed through a fine muslin cloth and the final volume was made upto 10 ml by adding distilled water.

**Olfactometer**

A multi-arm glass olfactometer was used for this study. The olfactometer has a central round chamber of 7 cm diameter and 3 cm height. Four tubes (each 2 cm diameter and 20 cm long) arise from the periphery of the central chamber with equal space ($90^o$) between them. The distal end of each arm is connected with a glass beaker (6 cm height and 4.5 cm diameter)

**Testing Procedure**

The host preference tests were conducted by choice tests in which leaves (Leaf Treatment–LT) and their water extracts (Extract Treatment–ET) were tested separately. In the case of ET, filter paper strips of 5 x 2 cm size were dipped in different plant extracts separately for 10 min and shade dried for 15 min. These filter paper strips, which were treated with different plant extracts, were put into separate beakers that were attached to the arms of the olfactometer. In one of the beakers, water hyacinth leaf extract treated filter paper strip was placed as control. The mouth of the beakers was closed with net. Six replications of each treatment set up were maintained. Ten newly emerged *N. bruchi* adult weevils were released into each olfactometer through the central opening. After three hours, the filter paper strips were taken out from each beaker of the olfactometer and the number of weevils found in them was counted. Excess proportion index (EPI) was calculated using the formula of Sakuma and Fukami (1985) to find out the orientation behaviour of the weevils towards different leaves and extracts. The EPI was calculated by the following formula :

$$EPI=NS – NC/NS + NC$$

Where, NS=Number of insects found in the sample side
NC=Number of insects found in the control side

In another experiment, fresh leaves of the chosen host plants were used in place of filter paper strips and the above procedure was repeated. The same procedure was followed to test the host preference of *N. eichhorniae* weevils. Feeding experiments were conducted by providing the leaves of different host plants to *N. bruchi* and *N. eichhorniae* weevils in plastic containers (100 ml). After every 24 h, the leaves were examined for any feeding scars and ovi-position on them produced by the weevils and this experiment was run for four days by providing fresh leaves every day.

## RESULTS AND DISCUSSION

The EPI values of *N. bruchi* and *N. eichhorniae* on 18 agricultural and horticultural crops were in the range of +0.33 and -1.00. The plus values indicate that the weevils prefer the host leaves and the negative values show that the weevils avoid the leaves and extracts of the plants. In general, the extracts were strongly avoided by the weevils. Pomegranate (+0.33) and paddy (+0.11) leaves showed positive values for *N. bruchi* and *N. eichhorniae*, respectively. All other plant leaf treatments exhibited negative values, which confirm that the weevils did not prefer the leaves other than water hyacinth (Figs. 1 and 2).

In the present study, positive values obtained in pomegranate and paddy leaves indicated the small preference of weevils towards these leaves. However, the results of the feeding experiments showed that the weevils did not feed on these leaves. Fig. 1 shows that *N. eichhorniae* strongly avoided blackgram (-1.00), groundnut (-1.00), brinjal (-1.00), capsicum (-0.93), tapioca (-1.00), coleus tuber (-1.00), lemon (-1.00), bitter gourd (-1.00) and mango (-1.00). Fig. 2 shows that *N. bruchi* strongly avoided paddy (-1.00), bitter gourd (-1.00), guava (-0.90), tapioca (-1.00), tomato (-1.00) and curry leaves (-0.88). The two weevil species showed differences in their avoidance behaviour as seen from these results. Oviposition and feeding scars by the weevils were not observed on the tested plants. Feeding scars and eggs were found only on the water hyacinth leaves indicating specificity for water hyacinth only. De Loach (1976) observed that *N. bruchi* was sufficiently host specific for introduction in U. S. to control water hyacinth, based on ovipositional preference and the

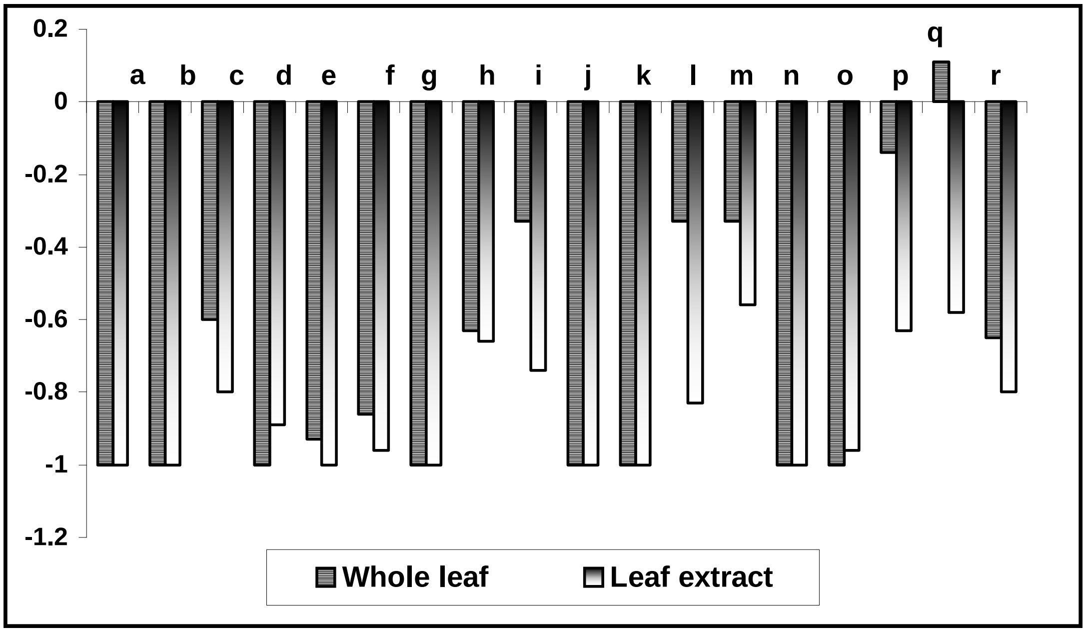


Fig. 1. Excess proportion index (EPI) values of *N. eichhorniae* on 18 agricultural and horticultural crops.

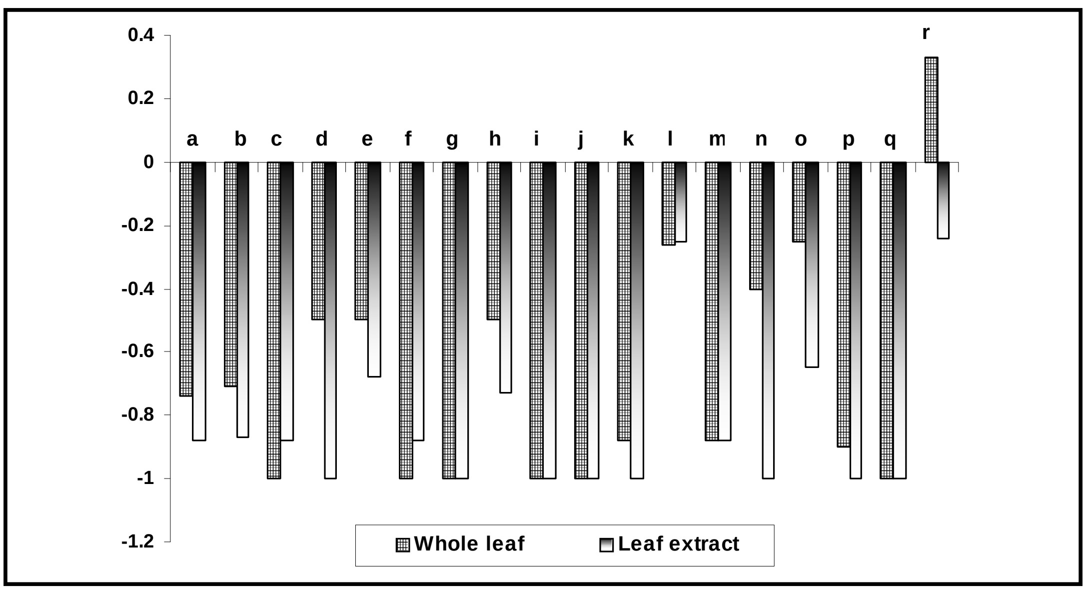


Fig. 2. Excess proportion index (EPI) values of *N. bruchi* on 18 agricultural and horticultural crops.

feeding of adults and larvae. *N. eichhorniae* which was imported into India in 1982 and found to be specific to water hyacinth (Nagarkatti and Jayanth, 1984) has already established under field conditions in Bangalore. These weevils entirely depend upon water hyacinth not only for feeding but also for breeding. De Loach and Cordo (1977) stated that the pupae of *N. bruchi* and *N. eichhorniae* were dependent on an intimate association with the living roots of water hyacinth and therefore they cannot complete their development on other plants or away from the aquatic environment.

From the present investigation, it is concluded that *N. bruchi* and *N. eichhorniae* are specific to water hyacinth plant. They prefer water hyacinth leaves and avoid all other plants tested here. Since they do not feed on any of the agricultural and horticultural crops tested in this study, these two weevil species therefore can be introduced into fresh water habitats to control the extensive proliferation of water hyacinth without any damage to other economically important plants or native vegetation.


## ACKNOWLEDGEMENTS

The authors are thankful to Dr. N. Sukumaran, Dean, Faculty of Sciences, Manonmaniam Sundaranar University, Tirunelveli, South India for his support. The authors acknowledge the financial assistance provided by the World Bank through the Environmental Cell of the PWD-WRO in the form of a pilot study on biological control of water hyacinth in Tamirabarani river basin.


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