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Comparative feeding efficiency of *Neochetina bruchi* and *N. eichhorniae* on water hyacinth under laboratory conditions at Raipur, Chhattisgarh

Parmeshwar Gore, Jayalaxmi Ganguli and Rashmi Gauraha

Abstract

Studies on the comparative feeding efficiency of the water hyacinth weevil, *Neochetina bruchi* and *N. eichhorniae* were conducted under laboratory conditions in the Biocontrol laboratory, department of Entomology, College of Agriculture, IGKV, Raipur. Based on the number of scrapings made by water hyacinth weevils in 24 hours on the leaves of water hyacinth, data revealed that *N. eichhorniae* scrapped more as compared to *N. bruchi*. It was also observed that the scars were more on the upper surface of leaves than on lower surface. *N. eichhorniae* formed 16.34 and 8.32 scars, where as *N. bruchi* formed 8.2 and 2.91 scars on the upper and lower surface of leaves respectively. Number of scrapings made by male and female weevils in 24 hours also differed and results revealed that females scrapped more as compared to males in both the species.

Keywords: Water hyacinth, water hyacinth weevils, *Neochetina bruchi*, *N. eichhorniae*

Introduction

hyacinth (*Eichhornia crassipes* Martius) is an exotic free floating perennial aquatic herb native to South America belonging to the family Pontederiaceae, closely related to Liliaceae has been reported as a noxious weed of fresh waters. Originally, it was introduced in 1884 for its beautiful flowers, but has invaded most of the Southern United States and many tropical and sub tropical regions around the world. The plants grow up to 1 m. high although 40 cm is the more usual height. The inflorescence bears 6 - 10 lily-like flowers, each 4 - 7cm in diameter. The stems and leaves contain air-filled tissues which provides buoyancy. It displaces native vegetation due to its rapid asexual reproduction and growth during summer. Major economic impacts caused by invasion of water hyacinth include interference with navigation, irrigation, fishing and power generation. Additionally, dense mats can provide ideal mosquito breeding habitats.

Management of this weed was earlier done by mechanical means and chemicals which were cost effective and toxic to the water bodies and non- target aquatic species. Hence, biological control was emphasized for invasive alien weed species that cannot otherwise be sustainably controlled.

Arthropods such as the water hyacinth weevils (*Neochetina eichhorniae* Hustache) and the related *N. bruchi* Warner have been reported to be used as biological control agents to reduce water hyacinth infestations, which were introduced as biological control agents to suppress the growth and reproduction of water hyacinth from Argentina and released in United States to help manage water hyacinth. In order to improve on the efficacy of the *Neochetina* weevils, the two species are often deployed together to control heavy water hyacinth infestations [2].

Observations of the amount of feeding damage and the sheer number of individuals suggest that the water-hyacinth weevils, *Neochetina eichhorniae* and *N. bruchi*, were the most injurious arthropods feeding on water-hyacinth plants in South Carolina. Every raft studied contained these weevils, both larvae and adults were present, and almost every plant was scarred by their activity [6].

Feeding damage caused by both species of weevils are complimentary and contributes to the suppression of water hyacinth. Adult beetle is 4 to 5 mm long and brownish to grey, and having a broad body which is robust and densely covered with fused brown tan scales. Antennae and lower leg segments are reddish brown. There are yellowish water-shedding

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scales on the leg joints. The snout is thick and weakly curved to straight in males; in females it is longer, more slender and more curved. Male is 3.5 mm in length and female is longer measuring 4.5 mm in length. The female's snout is noticeably shiny near the tip, where the scales have been rubbed away. This easily distinguishes females from males in both species [5].

Both male and female adults feed preferably on the narrow upper third region of the petiole and on the dorsal surface of the lamina particularly, of the first or second youngest leaf. Adults commence feeding within 24 hours of emergence. They feed externally by scraping the epidermal layer and some of the underlying cells to form small sub circular squarish scars which usually do not penetrate through the leaf to other side.

Looking to the above aspects, the present studies on the comparative feeding efficiency of *N. bruchi* and *N. eichhorniae* along with that of their male and female beetles were conducted to find out their better feeding capacity.

Materials and Methods

Stock cultures of water hyacinth (*Eichhornia crassipes*

(Mart.) Solms), were obtained from the local ponds of Raipur, Chhattisgarh, where as water hyacinth weevils, *Neochetina eichhorniae* and *N. bruchi* were initially obtained from DWR (Directorate of Weed Research), Jabalpur, Madhya Pradesh and maintained at Raipur.

The present studies were conducted under laboratory conditions in the Biocontrol laboratory, department of Entomology, College of Agriculture, IGKV, Raipur in plastic containers of 100 ml. capacity. Water hyacinth leaves were taken and some water was added to prevent the leaves from drying and one leaf per petridish was placed inside. Adults of *N. bruchi* and *N. eichhorniae* were selected and released as one, two, three, four and five pairs respectively replicated thrice. The setups were left undisturbed until complete feeding of leaves. During the experimental period, feeding scars of leaves was recorded every day. Control petridish were maintained with only water hyacinth leaves without any beetle.

The data on differences between the treatments and within the treatments were statistically analyzed by two-way ANOVA and t-Test.

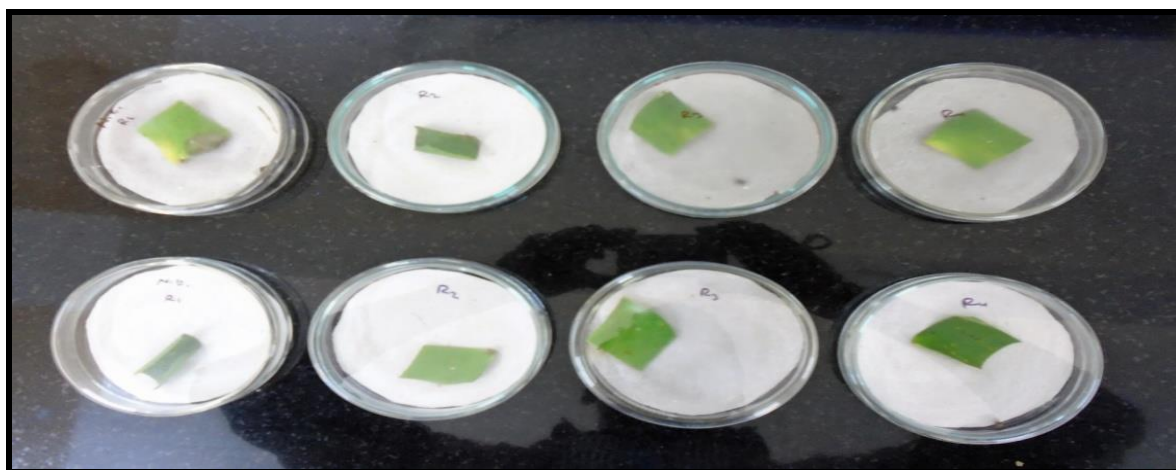


Plate 1: Comparison of feeding efficiency of *N. bruchi* and *N. eichhorniae*

2. Comparison of feeding efficiency of male *N. bruchi* and *N. eichhorniae*

The experiment was conducted under laboratory conditions in petridishes. Water hyacinth leaves were taken and some water was added to prevent the leaves from drying and one leaf per petridish was placed. Male *N. bruchi* and *N. eichhorniae* were

selected and released into the petridish, replicated thrice. The setups were left undisturbed until complete feeding of leaves. During the experimental period, feeding scars of leaves was recorded every day. The differences between the treatments and within the treatments were statistically analyzed by two-way ANOVA and t-Test.

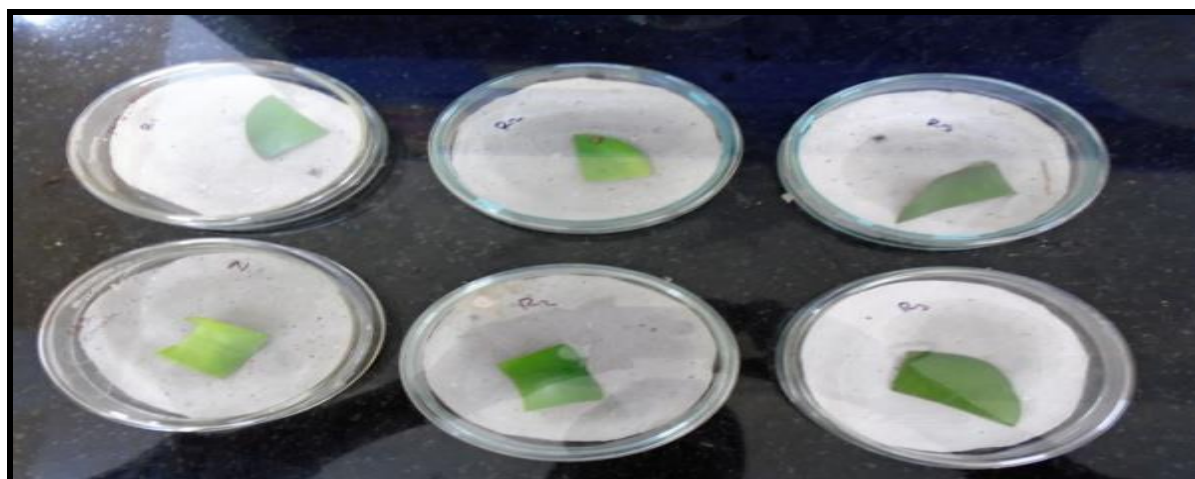


Plate 2: Comparison of feeding efficiency of male and female of *Neochetina* spp.

Comparison of feeding efficiency of female of *N. bruchi* and *N. eichhorniae*

The experiment was conducted under laboratory conditions in petridishes. Water hyacinth leaves were taken and some water was added to prevent the leaves from drying and one leaf per petridish was placed. Female *N. bruchi* and *N. eichhorniae* were selected and released into the petridish, replicated thrice. The setups were left undisturbed until complete feeding of leaves. During the experimental period, feeding scars of leaves was recorded every day. The differences between the treatments and within the treatments were statistically analyzed by two-way ANOVA and t-Test.

4. Comparison of feeding efficiency of adult *N. bruchi* and *N. eichhorniae* at different density.

The experiment was conducted under laboratory conditions in

plastic bottle. Water hyacinth leaves were taken and some water was added to prevent the leaves from drying and one leaf per plastic bottle was placed. Adult *N. bruchi* and *N. eichhorniae* were selected and released as one, two, three, four and five pairs respectively. The setups were left undisturbed until complete feeding of leaves. During the experimental period, feeding scars of leaves was recorded every day. Control petridishes were maintained with only water hyacinth leaves. Three replications of all sets were maintained.

The differences between the treatments and within the treatments were statistically analyzed by two-way ANOVA and t-Test.



Plate 3: Comparison of feeding efficiency of adult *N. bruchi* and *N. eichhorniae* at different density.

Results and Discussions

The results of the analyzed data on different experiments conducted to study the feeding capacity of *N. bruchi* and *N. eichhorniae* are presented below:-

I. Comparison of feeding efficiency of *N. bruchi* and *N. eichhorniae*

Number of scrapings made by adult water hyacinth weevils in 24 hours is presented in Table 1. Results revealed that *N.*

eichhorniae scrapped more as compared to *N. bruchi*. It was also observed that scars were more on the upper surface of leaves than on lower surface. *N. eichhorniae* formed 16.34 and 8.32 scars while *N. bruchi* formed 8.2 and 2.91 scars on the upper and lower surface of leaves respectively. (Table 1a) As far as the total number of scrapings on both upper and lower surface of the leaves was concerned significantly more number of scrapings were done by *N. eichhorniae* (Table 1b)

Table 1a. Mean number of scrapings made by adult water hyacinth weevils on water hyacinth leaves in 24 hours. (Mean± S.E.) (n=14)

Species	Parameters	
	Mean number of Scrapings per leaf on the upper surface	Mean number of Scrapings per leaf on the lower surface
<i>N. bruchi</i>	8.2±1.17	2.91±0.45
<i>N. eichhorniae</i>	16.34±1.91	8.32±1.1

Table 1b: Total number of scrapings made by water hyacinth weevils on water hyacinth leaves in 24 hours. (Mean± S.E.) (n=14)

Species	Total No. of scraping per leaves/insect/ day	t-Test
<i>N. bruchi</i>	11.11±2.88	Significant t-value= 4.11032 p-value= 0.000175
<i>N. eichhorniae</i>	24.66±1.6	

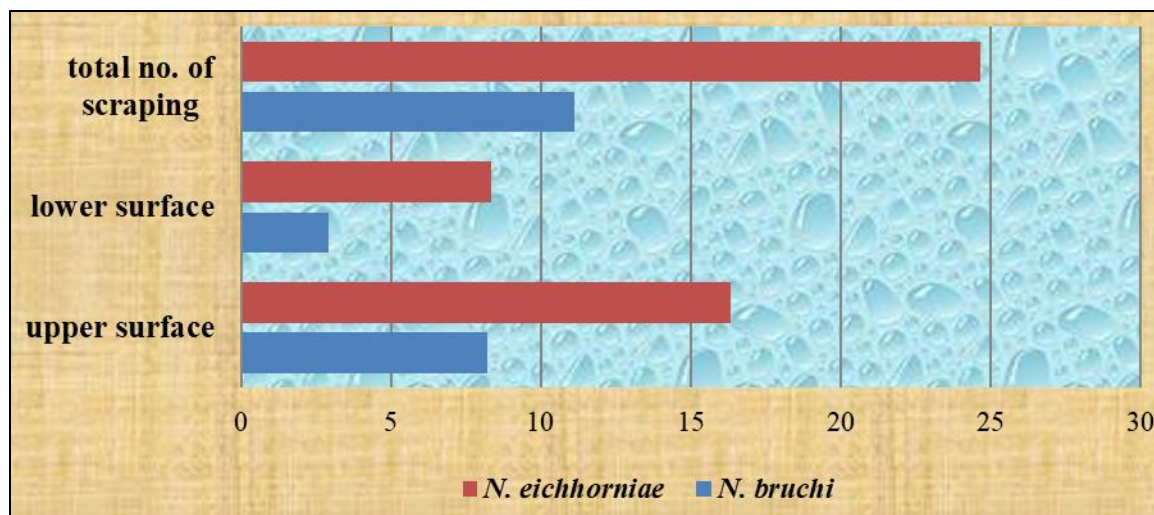


Fig 1: Graphical representation of number of scrapings made by water hyacinth weevils (/day) on water hyacinth leaves.

Similar findings were reported by [1, 4] who observed that the adult *N. eichhorniae* ate 86 mm² /day while *N. bruchi* ate a maximum of 75 mm² of water hyacinth leaves/day, and which is in agreement with present findings.

The present finding is also in agreement with [3], 1998 who also stated that more than 95% of the infestation of the aquatic weed was cleared within 32 months by releases of *Neochetina eichhorniae* Warner, which confirms its feeding efficiency.

II. Comparison of feeding efficiency of male and female of *N. bruchi* and *N. eichhorniae*

In order to study the comparative feeding efficiency of male and female of *N. bruchi* and *N. eichhorniae*, an experiment was conducted by releasing single individuals of male and female of both the species separately in petriplates replicated thrice provided with fresh leaves of water hyacinth, *E. crassipes*, and the number of scars formed on upper and lower

surface of the leaves were recorded after every 24 hrs. The leaves were replaced every day.

Number of scrapings made by male and female weevils in 24 hours is given in (Table 2.a & 2b) results reveal that females scrapped more as compared to males. A single *N. bruchi* male formed 6.66 scars on the leaves/ day, whereas the females formed 6.85 scars. (Table 2a) Similarly, *N. eichhorniae* males formed 7.28 scars/ day while the females formed 11.62 scars/ day. (Table.2b) From the data, it was concluded that in both the species females scrapped more than males. It was also observed that scars were more on the upper (dorsal) surface of leaves than on lower (ventral) surface. *N. bruchi* males formed 4.19 and 2.47 scars on the upper and lower surface of leaves respectively while *N. bruchi* females formed 4.57 and 2.28 scars on the upper and lower leaf surfaces respectively. *N. eichhorniae* males formed 4.47 and 2.8 and females formed 7.57 and 4.14 scars on the upper and lower surfaces of leaves respectively. (Table 3)

Table 2a. Total number of scrapings made by male and female *N. bruchi* weevil on water hyacinth leaves in 24 hours. (Mean±S.E.) (n=7)

Species	Sex	Total No. of scraping per leaves/insect/ day	t-Test
<i>N. bruchi</i>	Male	6.66±0.35	non significant t-value= 0.23545 p-value= 0.408616
	Female	6.85±0.73	

Table 2b: Total number of scrapings made by male and female *N. eichhorniae* weevil on water hyacinth leaves in 24 hours

Species	Sex	Total No. of scraping per leaves/insect/ day	t-Test
<i>N. eichhorniae</i>	Male	7.28±0.84	Significant t-value= 3.01769 p-value= 0.005354
	Female	11.62±1.17	

Similar findings as observed in the present studies of more feeding by female were reported by [1] who observed that the females ate 2.8 times as much as males and also in accordance

with [4] who reported more scrapings by the female in both species of weevils.

Table 3: Number of scrapings made by male and female of *N. bruchi* and *N. eichhorniae* on water hyacinth leaves of both surface in 24 hours. (Mean± S.E.) (n=7)

Species		Parameters		t-Test
		Number of Scrapings per leaf on the upper surface	Number of Scrapings per leaf on the lower surface	
<i>N. bruchi</i>	Male	4.19±0.25	2.47±0.19	Significant t-value= 5.4562 p-value= 0.000073
	Female	4.57±0.51	2.28±0.29	

<i>N. eichhorniae</i>	Male	4.47±0.38	2.8±0.53	Significant t-value= 2.57091 p-value= 0.0122
	Female	7.57±0.87	4.14±0.38	Significant t-value= 3.59988 p-value= 0.00182

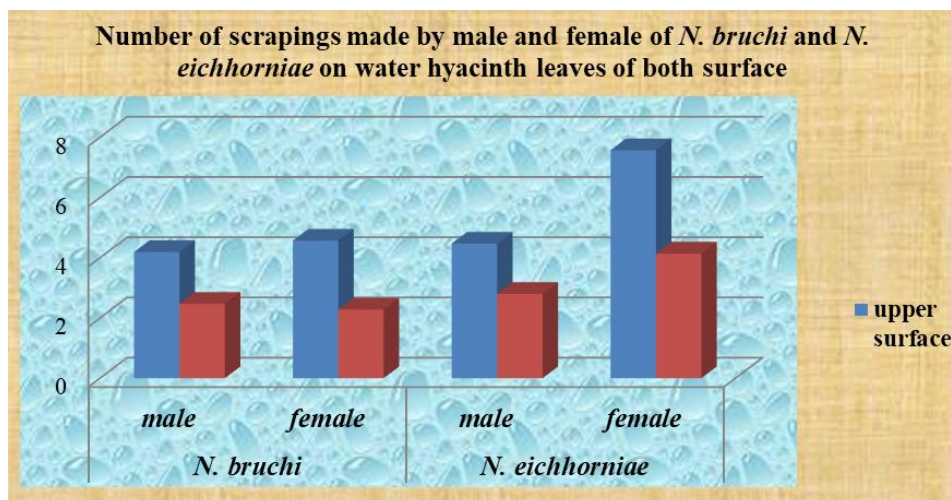


Fig 2: Graphical representation of number of scrapings made by male and female of *N. bruchi* and *N. eichhorniae* on water hyacinth leaves of both surface in 24 hours

III. Comparison of feeding efficiency of adult *N. bruchi* and *N. eichhorniae* at different weevil densities.

In order to test the feeding efficiency of adult *N. bruchi* and *N. eichhorniae* at different densities, an experiment was conducted on laboratory in plastic container (100ml.) containing two leaves of water hyacinth. Five treatments comprising of one, two, three, four and five pairs of weevils were released inside the containers and replicated thrice. The

leaves were replaced every day. The total number of feeding scars formed on upper and lower surface of the leaves were recorded after every 24 hrs. and the analyzed mean data is presented in Table 4.

The present finding is in line with [7] who stated that *Neochetina eichhorniae* had high specificity for both aquatic host plants i.e. *E.crassipes* and *E.azurea*, where leaves had high nitrogen content.

Table 4: Total number of feeding scars made by water hyacinth weevils /day on water hyacinth leaves at different weevil densities. (Mean± S.E.) (n=13)

Number of pair of weevils	Total number of feeding scars per leaf / per pair / day		t-Test
	<i>N. bruchi</i>	<i>N. eichhorniae</i>	
1	7.92±0.94	19.85±3.03	significant t-value= -2.8066 p-value= 0.004889
2	24.69±3.57	35.31±4.6	
3	44.62±5.17	69.15±8.45	
4	68.08±12.48	107.92±12.43	
5	85.15±10.11	117.38±9.48	

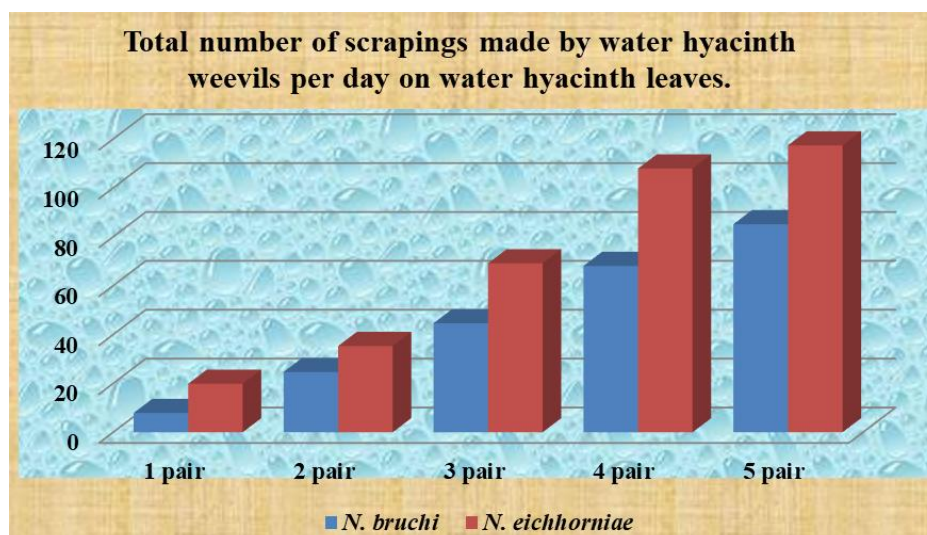


Fig 3: Graphical representation of number of scrapings made by different pairs of water hyacinth weevils on water hyacinth leaves

Conclusions

Thus, from the above studies conducted on the comparative

feeding efficiency of the two water hyacinth weevils, *Neochitina echhorniae* and *N. bruchi*, the former *ie*, *N.echhorniae* was better as it fed more by making more number of scars. Females were more efficient feeders as compared to males in both the species.

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