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Resurgence and Control of Water Hyacinth at a *Neochetina eichhorniae* Release Site in Bangalore, India

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Many of the large number of aquatic plants growing in India are of exotic origin (Gupta, 1976). Among these, water hyacinth *(Eichhornia crassipes)*, the free-floating weed of south American origin, infesting more than 200,000 ha of water surface (Anon, 1989), is considered to be the most serious. Two weevils, *Neochetina eichhorniae* Warner and *N.bruchi* Hustache (Coleoptera : Curculionidae) introduced from the U.S.A., have proved to be effective biological control agents of water hyacinth under field conditions (Jayanth 1988a,b).

In a 20 ha tank at Hebbal in Bangalore which was fully infested by water hyacinth, release of over 10,000 adults of *N.eichhorniae* between April and December 1984 resulted in 95% control by December 1986 (Jayath, 1988 a). Biological control was maintained in the above tank in 1987 also by *N.eichhorniae* along with *N.bruchi,* which had by then migrated by flight into this tank.

Under normal conditions, the Hebbal tank starts drying from the periphery every December. However, complete drying takes place only during summer seasons which are preceded by poor rainy seasons as in 1982 and 1986. The tank fills up again after commencement of rains in June. Seeds of water hyacinth, which remain in the tank bottoms are known to get activated and sprout after rains (Gopal and Sharma, 1981). During June 1987 increase in water hyacinth coverage from 2 to about 7% was noticed following germination of seeds, but was again brought back to its original level by the weevils.

As in other years, the water level in Hebbal tank started receding from December 1987. After about 2 metres of the tank bottom was exposed, 2 million gallons of sewage water was let in daily by the Bangalore Water Supply and Sewerage Board. As a result, the tank started getting filled up and full level was attained by January 1988. Within a short time, water hyacinth seeds, probably activated by the short duration of drying, were observed to sprout in large numbers. The plants which were already present covered about 500 sq.m. area and supported 2 adults per plant. These adults were unable to cope with the sudden spurt in weed population, resulting in rapid growth and multiplication of water hyacinth. Thus, by March 1988 about 50 per cent of the tank area was again under weed cover.

In response to the sudden increase in water hyacinth coverage in Hebbal tank, a committee on 'Eradication and control of water hyacinth' was set up by the Government of Karnataka under the Department of Ecology and Environment, in which the senior author was also a member. A number of different measures were proposed and an action plan, which included partial mechanical removal for reducing the existing weed population and desilting to remove seeds from the tank bottom, was drawn up. However, it was agreed that the population levels of the weevils be monitored for a few more months before implementing the proposed measures.

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As decided by the committee, the population levels of the weevils were recorded at monthly intervals from March 1988. For this, 50 water hyacinth plants were collected at random all along the periphery of the tank and the available adults were collected and counted. The number of leaves per plant as well as petiole lengths were also measured, besides making visual estimates of the weed coverage. The observations are summarised in Table 1.

The results clearly show that although water hyacinth coverage registered a 15-20 fold increase within 3 months from December 1987, the insects also kept pace by multiplying and spreading on all the available plants. The effect of insect feeding, in relation to plant damage, was negligible until April 1988. However, a comparison of plant growth parameters between April 1988 and March 1984, when insect releases were initiated for the first time, indicate that water hyacinth plants were not able to achieve their full growth potential, probably because of insect feeding. Thus in 1988, the maximum petiole length attained was 38.15 cm as compared to 58.3 cm in 1984.

Heavy damage to leaf laminae caused by adult feeding, was visible from April 1988, when the insect population reached 4.2 adults per plant. With this, the rapid growth phase of water hyacinth was brought to a halt and no further increase was noticed in plant coverage. This was also indicated by observations on the number of plantlets attached to a single plant. Upto March 1988 about 2 to 5 plantlets, connected by stolons, were found attached to each plant. This number reduced progressively and by June, only an occasional plant was found to be multiplying by vegetative means.

With the insect population touching 6 adults per plant in May 1988, browning of leaf laminae could be observed in patches and in June, water hyacinth plants started collapsing. Large scale collapse of the weed could be observed in July and August due to which the weed coverage was reduced to the 5 per cent level by September 1988. Thus, successful biological control was achieved once again within 6 months in the Hebbal tank, without making additional releases.

The results obtained in this study demonstrate once again that *N. eichhorniae*

Table 1. Effect of *Neochetina* spp. on water hyacinth in Hebbal tank

Date	Leaves per plant	Petiole length (cm)	Adults per plant	Remarks
Dec., 1987	7.70	24.80	2.00	About 1-2% weed coverage
Mar., 1988	7.90	29.30	3.08	Nearly 50% water surface covered by weed
Apr., 1988	8.06	38.15	4.20	Insect feeding damage visible on leaves
May, 1988	7.88	37.23	6.02	Browning of leaves
June, 1988	7.80	36.12	8.18	Large scale browning and beginning of collapse
July, 1988	7.50	34.20	10.84	Large scale collapse. Weed coverage reduced to about 25%
Aug., 1988	7.40	33.00	9.76	Weeds cover only about 10% of tank area
Sept., 1988	7.48	30.88	7.20	More than 95% control achieved

and *N.bruchi* are efficient biological control agents of water hyacinth. It is also clear that water hyacinth can never be eliminated from an infested water body, as seeds of the weed are capable of remaining viable for as long as 20 years (Gopal and Sharma, 1981). Therefore manual, mechanical and chemical methods of control are incapable of giving permanent and economical control of water hyacinth.

The rapid suppression of water hyacinth observed in this tank was possible only because weevils were already present when water hyacinth population started increasing. As the presence of a breeding population of the weevils is essential for the maintenance of biological control, the left over plants should not be removed. The fluctuations in weed cover are bound to continue for some more years until the huge reservoir of seeds at the tank bottom gets depleted, especially since fresh seeds are not being added to the water body due to scanty flowering.

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KEYWORDS : *N.eichhorniae, N. bruchi, Eichhornia crassipes*, biological control

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