ASSESSING THE IMPACT OF BIOLOGICAL CONTROL IN THE RIVERS KAGERA, MARA, PANGANI AND SIGI

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A Dissertation submitted to the Directorate of Research and Graduate Training in fulfillment of the requirements for the award of the Degree of Doctor of Philosophy of Makerere University

JULY 2007

ABSTRACT

Water hyacinth *Eichhornia crassipes* (Martius) Solms-Laubach, is considered to be the worst aquatic weed worldwide. Biological control using *Neochetina* weevils was initiated in Tanzania in1995; however this control mechanism was successful in Lake Victoria where water hyacinth was reduced by 80%, but failed in some water bodies (Rajabu *et al*., 2000; LVEMP, 2001). Studies were conducted during 2003 to 2005 to assess the impact of biological control in the rivers Kagera, Mara, Pangani and Sigi and to evaluate potential effect of nitrogen, phosphorus and silt on weevil establishment in greenhouse conditions at Kyaka near Kagera river in Kagera region, Tanzania. The objectives were achieved by studying the following aspects:

(i) The status of water hyacinth and *Neochetina* weevils in fresh water rivers (Kagera, Mara, Pangani and Sigi rivers) of Tanzania;

(ii) Effect of nitrogen and phosphorus on weevil establishment and damage on water hyacinth;

(iii) Effect of silt on establishment and performance of *Neochetina* weevils on water hyacinth; and

(iv) Effect of water quality on weevil establishment and damage on water hyacinth.

The study on rivers involved sampling of water hyacinth and determination of population densities and growth. Weevil densities, stages of development and feeding scars were also determined. Results showed that Kagera river had the highest water hyacinth

densities (44.2 plants m^{-2}) followed by Mara (32.8 plants m^{-2}), Pangani (27.2 plants m^{-2}) and least in Sigi (22.8 plants m^{-2}). Plant height was highest in Mara (51.04 cm), followed by Kagera, Pangani and the least height in Sigi (28.6 cm). Other plant parameters namely, leaf length and width and root length followed the same trend. Kagera river had the highest number of ramets per plant (1.13) followed by Mara, Sigi and Pangani (0.69). The number of adult weevils per plant was highest in Sigi (1.93) and Pangani (1.78) and lowest in Kagera and Mara (0). The number of weevil feeding scars per plant was highest in Pangani (22.1) and Sigi (17.81). Overall Mara (1.4) and Kagera (0.21) had the lowest. Water hyacinth growth suppression and population reduction was only evident in Pangani and Sigi rivers and was associated with abundance and feeding by weevils. On the other hand, the weed continued to proliferate in Kagera and Mara rivers in Lake Victoria basin despite monthly weevil releases.

The effect of N and P on water hyacinth growth and *Neochetina* weevil establishment and efficacy was conducted under greenhouse conditions. It consisted of 0 (control), 50 mg N L^{-1} , 100 mg N L^{-1}, 42.5 mg P L^{-1} and 85 mg P L^{-1} and their combinations. Weevil damage was suppressed at higher N (100 mg N L^{-1}) but not high P application rates. Plants fed with high levels of N had low counts of adult weevils and pupae. On the other hand, growth of water hyacinth was limited in low N by 40%, yet weevil numbers, eggs, larvae and pupae per plant as well as weevil damage, increased at low N. Similarly, the number of adult weevil feeding scars per plant was higher ($P<0.01$) in lower N than at high levels. However, P concentration had no significant effect on number of weevil feeding scars per plant. Total plant N and P varied among nutrient application rates and N uptake depended on P availability; and plant N content increased with increase in P application rate.

There was a significant positive correlation ($P<0.001$) between number of eggs and larvae per plant. The number and length of roots per plant increased with P application while application of N resulted to significant reduction in number and length of roots per plant. Water quality in the Kagera, Mara, Pangani and Sigi rivers differed. The highest total nitrogen was found in Kagera (0.99 mg N L^{-1}) while the lowest was in Sigi (0.12 mg N L^{-1}). Similary, total phosphorus was highest in Kagera (0.36 mg P L^{-1}), while the lowest was in Sigi (0.12 mg P L^{-1}). Likewise, electrical conductivity was highest in Kagera (969.8 µscm^{-1}) follwed by Mara while Pangani and Sigi had the lowest indicating pollution loads in Kagera and Mara rivers. Water temperature was high in Pangani (30.39 ^{o}C) and Sigi (29.4 ^{o}C), while Mara had (26.2 ^{o}C) and Kagera had the lowest (26.23 ^{o}C). Air temperatures and relative humidity followed the same trend. It was concluded that high N and P levels might be partly responsible for poor weevil damage on water hyacinth in eutrophic habitat such as in Kagera and Mara rivers. On addition, the low temperatures and relative humidity may have contributed by limiting the weevil activities.

The study on the effect of silt on the water hyacinth and weevil development and efficacy consisted of control (no silt applied) and silt at levels 17 kg, 51 kg and 85 kg in 50 litres of water applied in order to achieve distances of 20, 10 and 0 cm between the root tips and silt topmost level/surface. Silt and water for the experiments was from Lake Victoria and Kagera river. There was reduced weevil reproduction in treatments with silt as evidenced by low numbers of eggs, larvae, pupae and adult weevils. In contrast water hyacinth plant populations, leaf length and number of ramets were significantly enhanced ($P<0.05$) by silt application. Water hyacinth grown in water and silt from Kagera river, had higher weevil feeding scars per plant were 32.2 at low silt (17 kg) and 8.7 at 85 kg silt level indicating reduced weevil damage at high silt. A significant and positive relationship ($r = 0.881$, $P < 0.01$) was obtained between water hyacinth leaf length and lamina width. Silt levels appear to directly affect different life stages of the weevil, thereby reducing the ability of the insects to multiply to populations that can suppress growth of water hyacinth. Sediment loads in Kagera and Mara rivers may have contributed to poor establishment of *Neochetina* weevils and favoured water hyacinth proliferation.