

References

- BARTSCH, A.F. 1972. Nutrients and eutrophication prospects and options for the future. Nutrients and Eutrophication: The limiting nutrient controversy. *Limnol.Oceanogr. Special Symposia*. **1**, pp 297 - 317
- CENTER, T.D. 1987. Insects, mites and plant pathogens as agents of waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) leaf and ramet mortality. *J. Lake and Reserv. Manageme*. **3**. pp 285 – 293.
- CENTER, T.D. & SPENCER, N.R. 1981. The phenology and growth of waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) in an eutrophic north-central Florida lake. *Aquat. Bot.* **10**. pp 1-32.
- CENTER, T.D. & VAN T.K. 1989. Alteration of of waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) leaf dynamics and phytochemistry by insect damage and plant density. *Aquat.Bot.* **35**. pp 181-195
- CENTER, T.D., DRAY, F.A., JUBINSKY, G.P. & GRODOWITZ, M.J. 1999a. Biological control of Water Hyacinth Under Conditions of Maintenance Management: Can Herbicides and Insects Be Integrated ? *Environmental Management*. **23.2**. pp 241 – 256.
- CENTER, T.D., DRAY, F.A., JUBINSKY, G.P. & LESLIE, A.J. 1999b. Waterhyacinth weevils (*Neochetina eichhorniae* and *N.bruchi*) Inhibit waterhyacinth (*Eichhornia crassipes*) colony development. *Biological Control*. **15**. pp 39-50.
- CILLIERS, C.J. 1991. Biological Control of water hyacinth, *Eichhornia crassipes* (Pontederiaceae), in South Africa. *Agriculture, Ecosystems and Environment*. Special Issue: Biological Control of Weeds in South Africa. **37**. Elsevier. pp 1-3
- DEPARTMENT OF WATER AFFAIRS AND FORESTRY.1996. South African Water Quality Guidelines. **Volume 7: Aquatic Ecosystems**. Ed: S.Holmes, CSIR Environmental Services.

- DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 1999. Nutrient management in South Africa: where now? Internal Discussion Report, Department of Water Affairs and Forestry, Pretoria.
- EUROPEAN ENVIRONMENTAL AGENCY (EEA) 1998. The second assessment. European Environmental Agency, Copenhagen.
- GENSTAT FOR WINDOWS. 2000. Release 4.2. Fifth Edition. VSN International Ltd., Oxford.
- GOPAL, B. 1987. Water hyacinth. Elsevier, New York.
- GOSSET, D.R. & NORRIS, W.E. 1971. Relationship between nutrient availability and content of nitrogen and phosphorous in tissue of the aquatic macrophyte *Eichhornia crassipes* (Mart.) Solms. *Hydrobiologia*. **38**. pp 15-28.
- GROBLER, D.C. & SILBAUER, M.J. 1984. Impact of Eutrophication Control Measures on the Trophic Status of South African Impoundments. Water Research Commission Report 130/1/84
- HEARD, T.A. & WINTERTON, S.L. 2000. Interaction between nutrient status and weevil herbivory in the biological control of water hyacinth. *Journal of Applied Ecology*. **37**. pp 117 – 127.
- HILL, M.P. & CILLIERS, C.J. 1999. A review of the arthropod natural enemies, and factors that influence their efficacy, in the biological control of water hyacinth, *Eichhornia crassipes* (Mart.) Solms – Laubach (Pontederiaceae), in South Africa. In: *African Entomology Memoir No.1. Biological control of weeds in South Africa (1990 – 1998)*. Ed: T. Olckers and M.P. Hill pp- 103-113.
- HILL, M.P. & OLCKERS, T. 2001. Biological control initiatives against water hyacinth in South Africa: Constraining factors, success and new courses of action. Proceedings of the second meeting of the global working group for the biological and integrated control of water hyacinth, Beijing, China, 9 – 12 October 2000. Australian Center for International Agricultural Research. Canberra.

JULIEN, M.H. 2001, Biological Control of Water Hyacinth with Arthropods: a Review to 2000. Proceedings of the second meeting of the global working group for the biological and integrated control of water hyacinth, Beijing, China, 9 – 12 October 2000. Australian Center for International Agricultural Research. Canberra.

JULIEN, M.H., GRIFFITH, M.W. & WRIGHT, A.D. 1999. Biological control of water hyacinth. The weevils *Neochetina bruchi*, *N. eichhorniae*: biologies, host ranges, and rearing, releasing and monitoring techniques for biological control of *Eichhornia crassipes*. ACIAR Monograph. No 60.

JULIEN, M.H. & ORAPA, W. 1999. Structure and management of a successful biological control project for water hyacinth. Proceedings of the First IOBC Global Working Group Meeting for the Biological and Integrated Control of Water Hyacinth. Harare. Ed; M.P.Hill, M.H. Julien & T.D. Center. 16 – 19 November 1998.

KNIPLING, E.B., West, S.H. & HALLER, W.T. 1970. Growth characteristics, yield potential and nutritive content of water hyacinth. *Proc. Soil Crop Soc. Florida*, **30**, pp 51 - 63

MUSIL, C.F. 1977. The Application of Growth Kinetics for the control of *Eichhornia crassipes* and *Salvinia molesta* through nutrient removal. Proceedings of the Second National Weeds Conference of South Africa. Stellenbosch. 2-4 February. A.A. Balkema. Cape Town. pp 239-245

OCHIEL, G.S., NJOKA, S.W. MAILU, A.M. & GITONGA, W. 2001. Establishment, Spread and Impact of *Neochetina* spp. on water hyacinth in Lake Victoria. Proceedings of the Second Meeting of the Global Working Group for the Biological and Integrated Control of Water Hyacinth, Beijing, China, 9 – 12 October 2000. Australian Center for International Agricultural Research. Canberra.

O'KEEFFE, J.H. , PALMER, R.W. , BYREN, B.A. & DAVIES, B.R. 1990. The effects of impoundments on the physiochemistry of two contrasting South African River Systems. *Regulated Rivers: Research & Management*. **5**. pp 97 – 110.

PALMER, R.W. & O'KEEFFE, J.H. 1990. Downstream effects of impoundments on the water chemistry of the Buffalo River (Eastern Cape), South Africa. *Hydrobiologia*. **202**. pp 71-83

- PEARCE, T. 1987. A preliminary investigation of the effects of water hyacinth on algal growth and water quality. Water Research Commission Report 142/1/87
- PENFOUND, W.T. & EARL, T.T., 1948. The biology of the water hyacinth. *Ecological Monographs*. **18**. pp 447 – 472.
- REDDY, K.R., AGAMI, M & TUCKER, J.C.1989. Influence of Nitrogen supply rates on growth and nutrient storage by water hyacinth (*Eichhornia crassipes* (Mart.) Solms) plants. *Aquatic Botany*, **36** (1990) pp 33 – 34.
- REDDY, K.R., AGAMI, M & TUCKER, J.C.1990. Influence of phosphorous on growth and nutrient storage of water hyacinth (*Eichhornia crassipes* (Mart.) Solms) plants. *Aquatic Botany*, **37** (1990) pp 355 – 365.
- SNEDECOR, GW & COCHRAN, WG. 1980. Statistical methods (7th Ed.). Iowa State University Press.
- THORNTON, J.A. & WALMSLEY, R.D. 1982. Applicability of phosphorous budget models to South African man-made lakes. *Hydrobiologia*. **89**. pp 237 – 245.
- UECKERMANN, C & HILL, M.P.2001. Impact of herbicides used in water hyacinth control on natural enemies released against the weed for biological control. WRC Report no 915/1/01
- UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA). 1999.
- VAN, T.K. & CENTER, T.D. 1994. Effect of paclobutrazol and waterhyacinth weevil (*Neochetina eichhorniae*) on the plant growth and leaf dynamics of waterhyacinth, (*Eichhornia crassipes*) *Weed Science*. **42**. pp 665 – 672.
- WALMSLEY, R.D. & BUTTY, M. 1980.Guidelines for the control of Eutrophication in South Africa. UDC574.524 (680)
- WALMSLEY, R.D.2000. Perspectives on Eutrophication of surface waters: Policy/Research Needs in South Africa. WRC Report KV129/00

WRIGHT, A.D. & CENTER.T.D.1984.Predicting population intensity of adult *Neochetina eichhorniae*(Coleoptera: Curculionidae)from incidence of feeding on leaves of waterhyacinth *Eichhornia crassipes*. *Environ. Entomol.* **13**. pp 1478 – 1482.

WRIGHT, A.D. & PURCELL, M.F. 1995. *Eichhornia crassipes* (Mart.) Solms – Laubach. In: The biology of Australian weeds. Eds R.H. Groves, R.C.H Shephard and R.G. Richardson. R.G. and F.J. Richardson, Melbourne. pp.111-121.

Mites	<i>Eriothrips eichhorniae</i> Curvaldo	Water hyacinth sap-sucking bug	1996
Acarina Gallesnidae	<i>Ornithogalumna ischirata</i> Walwerk	Water hyacinth mite	1996
Pathogen	<i>Cercospora perniciosa</i> & <i>C. malvarum</i> Thurn	Cercospora	1986

Table 1. The different parameters of the water hyacinth plant and its biological control insects collected at Hammarsdale Dam per individual plant, per sample.

Plant parameters	Biological control insect parameters
Wet weight	Number <i>Neochetina eichhorniae</i> and <i>N. bruchi</i> present (male and female)
Maximum petiole length	Presence of the <i>Neochetina eichhorniae</i> and <i>N. bruchi</i> larvae
Root length	Number of weevil feeding scars on leaf 2
Leaf 2 petiole length	Number of <i>E. eichhorniae</i> third instar pupae on leaf 2
Area of leaf 2	Number of <i>E. eichhorniae</i> nymphs
Number of daughter plants	Number of <i>E. eichhorniae</i> adult
Number of petioles above water surface	Number of <i>G. eichhorniae</i> on leaf 4
Number of petioles below water surface	The estimated percentage of the leaf damaged by the mite