"International Trade and Invasive Alien Species"

12-13 July 2012

WTO Building, Conference Room CRI

SPEAKER NOTES

Ms Nagat Mubarak El Tayeb, Sudan, STDF developing country expert

Ms Nagat Mubarak El Tayeb is the ex-director of the Plant Quarantine Directorate, Ministry of Agriculture, Sudan. She is a Botanist /Plant Pathologist with a Ph D in the biological control of weeds using plant pathogens from the University of Khartoum. After graduation she worked for water hyacinth control section of the Plant Protection Directorate, in this capacity she was responsible of the management of the weed and participated in the Biological Control Project. Prior to Plant Quarantine she was worked as the Director of the weed management Department. The Department mandate is the management of weeds of national importance mainly invasive alien species, in this capacity she gained experience in the management and coordinated research programs of the IAS water hyacinth, mesquite (Prosopis sp.) and the noxious weeds Striga and Orobanche. She worked for the IPPC as a training consultant. Currently she is an STDF Developing Country Expert and a member of IPPC expert Working Group in Capacity Development.

Speaking Notes

Successful biological control of water hyacinth *(Eichhornia Crassipes)* by *Neochetina* weevils in Sudan

1. Introduction

The aggressive floating aquatic weed water hyacinth (*Eichhornia crassipes* (Mart.) Solms.) is one of the most invasive species in the world. The plant is a native to the Amazon River from there it invaded the tropical world over the last century and has become an extremely serious weed. Water hyacinth has a rapid propagation and morphological characteristics that makes the weed well adapted to rapid distance dispersal and successful colonization of varying habitats in a short time (Obeid, 1984). Sudan probably has the longest history of water hyacinth control in Africa. The weed was first reported near Bor town (now in Southern Sudan) about 1954, presumably having invaded from the Congo River, where it had spread since 1952. In 1958-59, Sudan declared it as a national pest and then put legislation in place to control it. Water hyacinth breeded continuously in the river section between Juba and Malakal, discharged through the river section between Malakal and Kosti, and then lodged over a further 300 km down the Nile between Kosti and Jebel Awalia Dam.

2. Socioeconomic effects

From its first observation in the mid 1950's it increased rapidly to infest 3700 km2 water bodies of the White Nile system in the Sudan. The introduction and rapid spread of the water hyacinth in the White Nile produced serious economic and ecological problems for the use of that river as a resource. The weed completely displaced indigenous the flora of the white Nile and its tributaries, decreased the productivity of the river by blocking light from penetrating the river water, which induced changes in the flora and fauna underneath, hindered fish production and resulting in unemployment and diminished incomes and food for riparian communities; caused eutrophication under actively growing mats and therefore affected water quality; clogged irrigation canals reducing the amount of water they usually deliver, particularly at their tail ends; waterways and even ports got too clogged for boats to go through. The effects on navigation included 50% higher running and maintenance costs and 30% more use of fuel. It also inflicted increased health hazards i.e. incidence malaria and schistosomiasis (Navarro and George Phiri, 2000)

The water loss through evapotranspiration caused by E. crassipes was greater than that resulting from indigenous weeds, free water surface and wet soil. E. crassipes growing on soil can play a significant role in depleting the soils of the river banks of water. The rate of water loss proved to be a function of the prevailing climatic conditions. The annual total loss caused by E. crassipes in the Sudan was calculated to be 7 milliards m3, taking the total area infested by E. crassipes in the country to be 3000 km2 (Desougi and Obeid, 1978).

3. Utilization

The River Nile was reported to produce 50 million tons of plant material annually (Abdalla and Abdel Hafeez, 1969). Many attempts for utilization of the enormous biomass in a wide variety of ways including its use as a fertilizer, mulch or compost, in biogas production, to increase crop yields and as silage and hay were evaluated (Philip et al.1983). The cost of harvesting deterred all attempts for utilization.

4. Control

4.1 Chemical Control

Sudan initiated efforts to combat the weed in 1959, giving responsibility for this to the Water Hyacinth Control Division under the Plant Protection Department of the Ministry of Agriculture. Priority was given to easing the constraints on navigation. The initial control strategy was chemical, using the herbicide 2-4,D. This cost almost 1.5 million USD annually. Chemical control proved unsatisfactory not least of these is the increasing cost of chemical control of the weed in a very large and often inaccessible areas (Navarro and George Phiri, 2000). The same infestation was recorded every year because of regeneration of the plant from the rhizomes, which are not usually affected by herbicide application, and from the remaining fragments of the plant after application.

4.2 Physical control

Sudan has used physical methods but considered them expensive. Using casual and permanent labour for manual removal costs almost 160 USD/ha, for instance, and using a prototype mechanical harvester costs almost 115 USD/ha. In nearly all cases, manual removal has not effectively controlled the weed (Navarro and George Phiri, 2000)

4.3 Biological control

The introduction of some of its natural insect enemies had been earlier suggested as an alternative method of control. The Plant Protection Department, the National Council for Research, and the University of Khartoum carried out a project using biological control. The United Kingdom Overseas Development Administration (now Department for International Development, DFID) partially financed this project through the Commonwealth Institute of Biological Control (later known as IIBC and now as CABI Bioscience). Two species of Neochetina weevils were released and established, together with the moth Sameodes albiguttalis (Warren), in 1978-79. A programme for the mass culture and release of insects in the Sudan commenced early in 1979. During the following two years three species, Neochetina eichhorniae Warner, N. bruchi Hustache (Col., Curculionidae) and Sameodes albiguttalis (Warren) (Lep., Pyralidae) were reared and released. The Neochetina weevils became successfully established and dispersed in the river system. Heavy infestations have been observed in some areas. The moth S. albiguttalis was not as successful. The adults of these weevils attack the plant and feed by removing tissues from the leaf pseudolamina and petioles. The larvae tunnel inside the petioles and the crown. The optimum temperature for feeding and development of both species is 25° C. Results obtained from stocking hyacinth plants with adults and larvae of both species separately revealed that N. bruchi is more efficient in checking the growth of the plant. The progeny of a pair of N. bruchi and N. eichhorniae reared separately on 41 hyacinth plants for a period of 61 days (one generation period) reduced their population growth by 25.4% and 12.7% respectively. The progeny of both species in a mixed culture reduced the growth of the plants by 22.5% in the same period, while in the control the population of the plants increased 136.6% (Bashir; El Abjar and Irving, 1984). The cost of biological control was 1 million USD over a 5-year period.

Studies were also made in the Sudan to test microorganisms pathogenic to water hyacinth for biological control purposes. In field studies Alternaria eichhorniae was reported to cause 100% kill in combination with N. bruchi and N. eichhorniae (El Tayeb, and Bashir, 1992).

Successful biological control water hyacinth was achieved and a significant reduction in the infestation of the weed on the Nile System was evident by 1982. The insect infestation significantly checked the reproduction of the plant. All the discharge area is now free from the weed (300 km). A marked the regeneration of indigenous species of the Nile was also evident. Since 1982 all control activities has been stopped. The success of this project have saved millions of hard and local currency annually spent on the purchase of herbicides and other logistics of the control campaigns. To this, is added the invaluable gain of ridding the Nile ecosystem from multitude of ecological problems created by the pollution effect of herbicides.

5. References

Abdalla,A A. and Abdel Hafeez A.T.1969.Some aspects of utilization of water hyacinth (Eichhornia crassipes). PANS 15, 204.

Bashir, M.O.; El Abjar, Z. E. and Irving, N.S. 1984. Observations on the effect of the weevils Neochetina eichhorniae Warner and Neochetina bruchi Hustache on the growth of water hyacinth. Hydrobiologia, 110: 95-98, Limnology and Marine Biology in the Sudan.

Desougi, L.A. and Obeid, M.1978. Some aspects of the evapotranspiration of Eichhornia crassipes and some other aquatic weeds. Proceedings 5th EWRS International Symposium on Aquatic Weeds, Amsterdam, pp 391-398.

El Tayeb, N. M. and Bashir, M.O. 1992. Evaluation of Alternaria eichhorniae as a biocontrol agent of water hyacinth in the Sudan. Proceedings of the French-Sudanese Symposium on Phytopathology. INRA and ARC, ARC, Wad Medani, Sudan, 21-24.

Irving, N.S. Bashir, M. O. 1982. Introduction of some natural enemies of water hyacinth to the White Nile, Sudan. Tropical Pest Management 28 (1), 20-26.

Navarro L. and Phiri G. 2000. Water Hyacinth in Africa and the Middle East A Survey Problems and Solutions. In: Luis Navarro and George Phiri eds. The International Development Research Centre, Ottawa, Canada.
Obeid, M. (1984). Water hyacinth, (Eichhorina crassipes Mart.) solms. in Sudan. Proceedings of the international conference on water hyacinth . Hyderabad , India, pp. 145-148.
Philip O; Koch, W. and Koser H.1983. Utilization and Control of Water Hyacinth in Sudan .GTZ, Eschborn, 224 pp.