Journal of Tropical Agriculture 42 (1-2): 21-23, 2004

Fungi occurring on water hyacinth [*Eichhornia crassipes* (Mart.) Solms] in Kerala

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Received 29 July 2003; received in revised form 1 August 2004; accepted 3 August 2004

Abstract

Water hyacinth is one of the most invasive aquatic weeds of Kerala. A survey was conducted in the waterways of four southern districts of Kerala to document the fungal pathogens of water hyacinth. Out of the 21 fungi recorded, 17 were pathogenic. Among these, *Myrothecium advena* Sacc. is a new report on water hyacinth. Furthermore, *M. advena* and *Fusarium pallidoroseum* (Cooke) Sacc. caused more than 50% infection of the weed and hold promise as biocontrol agents of water hyacinth.

Key words: Biological control, *Myrothecium advena, Fusarium pallidoroseum*

Introduction

Water hyacinth [*Eichhornia crassipes* (Mart.) Solms], popularly known as *kulavazha*, is one of the most invasive and gregarious aquatic weeds of Kerala. Although it reproduces mostly by offshoots, seeds too play a major role in the survival and colonization of water hyacinth (Charudattan, 1982). In Kerala, it is widely seen in the paddy fields, lakes, streams and channels, making large areas uncultivable, inaccessible and non-navigable. Water hyacinth also interferes with hydropower generation and obstructs water flow in irrigation channels; besides, facilitating rampant mosquito breeding in the aquatic systems, and fostering water-borne diseases. During the last decade or so, water hyacinth spread throughout Kerala causing widespread problems to the public who use these water bodies and other static water resources (Singh, 1999). The alleviation of this problem, therefore, will greatly benefit the people whose livelihood security and health are threatened by the spread of this weed.

The management of water hyacinth is possible through physical, chemical or biological means. Mechanical removal and use of herbicides, however, have been found to be either inadequate or too expensive especially in large tracts. In recent years, therefore, the focus shifted to natural enemies of water hyacinth including plant pathogens. Since the main means of propagation of the weed is through offshoots, water hyacinth is thought to be a good candidate for biological control. In particular, the success of the host-specific *Cercospora rodmanii* in controlling water hyacinth greatly stimulated interest in the management of the weed using fungal pathogens (Conway, 1976; Conway and Freeman, 1977). The Abbott Laboratories of USA developed an experimental formulation of *C. rodmanii*, named ABG-5003, against *E. crassipes* (Te Beest, 1991).

Although water hyacinth existed in Kerala for a long time, its biocontrol using plant pathogens has seldom been attempted locally. The aim of the present work, therefore, is to explore the possibility of using native pathogens as biocontrol agents of water hyacinth.

Materials and Methods

A survey was conducted to document various fungal pathogens of water hyacinth in the waterways of the four southern districts of Kerala *viz*., Thiruvananthapuram, Kottayam, Alappuzha and Kollam at quarterly intervals. In each district, five locations were surveyed and plants

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that developed symptoms like spots, lesions, rots and browning were collected. From the diseased specimens, the fungi were isolated and maintained in potato dextrose agar (PDA).

Pathogenicity was proved by inoculating seven day-old cultures of the fungi on healthy water hyacinth plants maintained in plastic pots (15x15 cm). Observations on the nature of symptoms and time taken for its development were recorded. In addition, the extent of damage was evaluated using a *0* to *6* score chart; where *0* represents no foliar symptoms, *1* means symptom development around the pin-pricked area only, *2* and *3* indicate yellowing/browning up to 10% and 11 to 25 % of the leaf area respectively, *4* and *5* signify such symptoms respectively over 26 to 50% and 50 to 75% of the foliar area including petioles, and *6* denotes complete drying of the plants. The disease index was calculated using the formula (Mayee and Datar, 1986).

$$\text{Disease index (DI)} = \frac{\text{Sum of the score for each leaf}}{\text{No. of leaves scored} \times \text{Maximum score}} \times 100$$

Results and Discussion

Among the four districts surveyed, waterways in Kollam district were less frequently infested with water hyacinth. Out of the 21 fungi recorded in the survey, 17 were pathogenic (Table 1). Of these, *Curvularia lunata, Colletotrichum gloeosporioides, Fusarium pallidoroseum, F. moniliforme, F. oxysporum* and *Myrothecium advena* were observed consistently in all the areas surveyed. Previous studies on the fungal flora of water hyacinth by Santhi (1994) and Susha (1997) also indicated the occurrence of *C. lunata, C. gloeosporioides, F. equiseti, F. pallidoroseum* and *Rhizoctonia solani*, implying their widespread occurrence in the study area.

Furthermore, among the different pathogenic fungi, *M. advena* isolated from Thiruvananthapuram, Kottayam and Alappuzha is a new record on water hyacinth. Apart from water hyacinth, this fungus is reported to occur on coffee also (Nagraj and George, 1960). Regarding symptoms, initially roundish oil-soaked spots appear mainly on the leaves, and yet rarely on the stems, which turn brown towards the later stages. Eventually, these spots enlarge with the rounded side facing the petiole and tapering to a narrow point in the direction of the laminar tip. Additionally, on the upper surface of the leaves, distinct concentric zonations appear giving a target board appearance. The fruiting bodies of the fungus are also noticed on the upper surface along these concentric rings.

Table 1. Pathogenicity of fungi isolated from water hyacinth

Fungus	Time taken for symptom development (days)	Pathogenicity
Alternaria eichhorniae	5-6	++
Aspergillus sp.	-	-
Colletotrichum gloeosporioides isolates 1 and 2	7-10	+
Curvularia lunata	10	+
Fusarium equiseti	10	+
F. moniliforme isolates 1 and 2	6–8	++
F. oxysporum isolates 1 and 2	5–7	++
F. pallidoroseum isolates 1 and 2	5–7	++
F. pallidoroseum isolate 3	4–5	++
Helminthosporium sp.	7	++
Myrothecium advena	2	+++
Nigrospora sp.	-	-
Penicillium sp.	-	-
Pestalotia sp.	8-10	+
Rhizoctonia solani	7	++
Sterile fungus	7	++
Trichoderma sp.	-	-

- avirulent, + moderately virulent, ++ virulent, +++ highly virulent

Based on the time taken for the development of symptoms, the pathogens were classified into four categories *viz*., *highly virulent, virulent, moderately virulent* and *avirulent*. The highly virulent pathogens developed symptoms within three days of artificial inoculation, while the virulent isolates took 3-7 days, and the moderately virulent needed more than seven days for the expression of symptoms; the avirulent, nevertheless,

did not produce any symptoms. *M. advena* was the only fungus in this study that could be grouped under the highly virulent category, as it developed symptoms within two days of artificial inoculation (Table 1). *C. gloeosporioides, C. lunata, F. equiseti* and *Pestalotia* sp. are examples of the moderately virulent pathogens, while *Alternaria eichhorniae, Fusarium* spp., *Helminthosporium* sp. and *R. solani* constituted the virulent category. Four fungi *viz*., *Aspergillus, Penicillium, Nigrospora* and *Trichoderma* sp., nonetheless, failed to elicit any symptoms. Furthermore, variations among the isolates of *C. gloeosporioides, F. moniliforme, F. oxysporum* and *F. pallidoroseum* were modest.

The extent of damage produced by the pathogenic fungi on water hyacinth (Table 2) ranged from 16.67 (*C. lunata* and sterile fungus) to 61.11% (*M. advena*). Only two fungi *viz. M. advena* and *F. pallidoroseum*, however, caused more than 50% infection. Earlier, Santhi (1994) too reported 51% infection for *F. semitectum* (syn. *F. pallidoroseum*) on water hyacinth. Our data further highlight that the intensity of *F. oxysporum* infection ranged between 40 and 50%; and for the other fungi, it was less than 40%.

Table 2 Extent of damage caused by pathogenic fungi on water hyacinth

Pathogenic fungi	Intensity of infection (%)
Alternaria eichhorniae	44.44
Colletotrichum gloeosporioides isolate 1	35.24
C. gloeosporioides isolate 2	46.21
Curvularia lunata	16.67
Fusarium equiseti	42.44
F. moniliforme isolate 1	41.72
F. moniliforme isolate 2	41.21
F. oxysporum isolate 1	44.44
F. oxysporum isolate 2	40.87
F. pallidoroseum isolate 1	45.09
F. pallidoroseum isolate 2	43.14
F. pallidoroseum isolate 3	53.44
Helminthosporium sp.	27.77
Myrothecium advena	61.11
Pestalotia sp.	22.22
Rhizoctonia solani	31.24
Sterile fungus	16.67

Results of the study clearly indicate that among the several fungi isolated from water hyacinth, *M. advena* and *F. pallidoroseum* are promising biocontrol agents. Further tests are, however, needed before their use in large-scale biological control programmes.

Acknowledgements

This paper forms a part of the PhD thesis submitted to Kerala Agricultural University by the senior author.

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