Fusarium pallidoroseum for management of water hyacinth

Water hyacinth [*Eichhornia crassipes* (Mart.) Solms], a native of Amazon river basin in South America is a troublesome aquatic weed all over the world. It was introduced into India in 1896 as an ornamental pond plant. Now this weed is seen infesting more than 200,000 ha of water surface[1], causing concern in 98 out of 246 districts in India[2]. This fast multiplying weed can produce 3000 offspring in 50 days and can double its biomass in 10–12 days.

Even though water hyacinth can be used in compost making, paper industry, biogas plants, furniture making, wastewater treatment and as cattle feed, there are no reports of large-scale use of this weed in India, and it still continues to be a great menace in our country. The disadvantages of this weed outweigh its merits. It interferes with production of hydroelectricity, blocks water flow in irrigation and drainage canals, channels and streams leading to flooding and seepage into adjoining areas, hinders anti-mosquito operations and forms a breeding ground for obnoxious insects like mosquitoes which transmit infectious diseases such as malaria and encephalomyelitis. It also affects the aquatic fauna through elimination of habitat and depletion of oxygen level caused by respiration and decomposition of vegetative parts. The excessive weed population is strong enough to stop boats or slow down navigation. It also makes recreational water activity difficult and unsafe in lakes. It also serves as an alternate host to several insects, pathogens and their chances of damage caused by this weed on crop plants are increased. The water loss due to evapotranspiration from the luxuriant foliage of water hyacinth is a major concern, where water shortages have become chronic.

The management of water hyacinth could be taken up by mechanical, chemical or biological means. The most widely followed practice among the people is by manual collection and destruction. Since the weed multiplies rapidly and the expense involved in manual collection is high, alternative methods are being investigated.

Chemical destruction of the weed by herbicides though successful, is not feasible in most cases, as the water in which the weed grows is being utilized for drinking purpose by animals and for other household uses. Chemical herbicides cannot provide long-term solution to the weed problem.

The science of biological control has made significant contribution for the successful management of alien weeds in many countries around the globe. However, not all weeds are amenable to biological control. It is ideally suited in situations where a few aggressive weeds, often introduced ones, dominate large areas. So water hyacinth is an ideal candidate to be managed using biological agents.

The use of microorganisms in the management of weeds is gaining attention all over the world. Mycoherbicide is a plant pathogenic fungus developed and used in bioherbicidal strategy to control weeds. This could be used in the same way as chemical herbicides. De Vine, marketed by Abbott Laboratories, USA is the first registered mycoherbicide. The formulation contains chlamydospores of *Phytophthora palmivora* in V-8 juice medium[3]. This was effective in the management of strangler vine (*Morrena odorata*), a problem weed in citrus orchards. Among the fungi tested so far, *Cercospora rodmanii* have shown the greatest promise as biocontrol agents of water hyacinth[4]. Currently, more than eight mycoherbicides are being marketed commercially in different countries. Lack of shelf life and congenial environment for infestation and development are the limitations.

Studies conducted in the Department of Plant Pathology, College of Agriculture, Vellayani, indicated that *Fusarium pallidoroseum*, a wilt-inducing pathogen isolated from water hyacinth could restrict the multiplication and thus cause reduction in the population of the weed[5]. The initial symptom produced by the pathogen is brown spots with prominent yellow halo towards the tip and margins of the leaves, which later enlarged to form large brown, irregular lesions spreading from the tip downwards, covering a major area of the leaves and resulting in the blighting and drying up of the leaves. Similar symptoms were observed on the petiole and swollen portion, resulting in the drying and sinking of the whole plant to the bottom of the lake. The safety of the pathogen was tested on cultivated plants of Kerala as well as on common weeds seen near the waterways coming under 47 families. This included 53 species of cultivated plants such as vegetables, pulses, oil seeds, plantation crops, fruits and forest trees and 54 species of weeds. The results of the study revealed that the fungus was pathogenic only on six cultivated plants (amaranthus, tomato, banana, cashew, colocasia and papaya) and 20 weeds. Even in these cases it produced only isolated spots, especially on older leaves.

F. pallidoroseum was formulated as a wettable powder (40%) and was tested on water hyacinth plants under glasshouse condition, in tanks and in an infested lake (Akkulam) at Thiruvananthapuram. Based on the results of the glasshouse

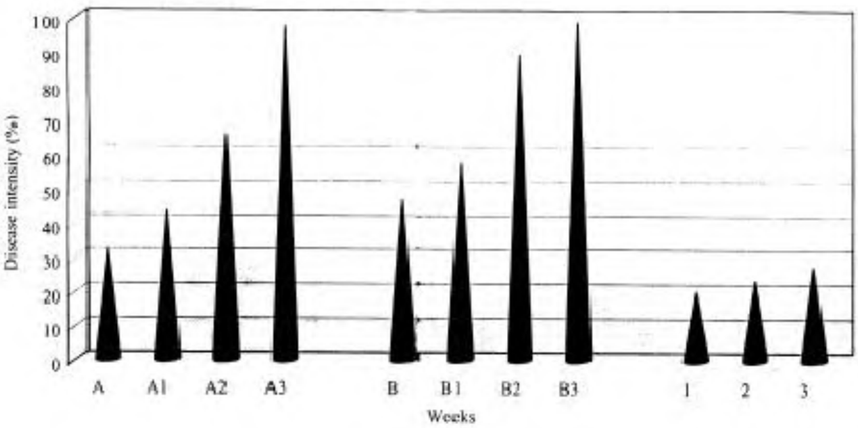

Figure 1. Effect of wettable powder formulation on water hyacinth under trough conditions. A, WP @ 5 g/100 ml; B, WP @ 10 g/100 ml; 1, 2% CNSL; 2, 3% CNSL; 3, 4% CNSL.

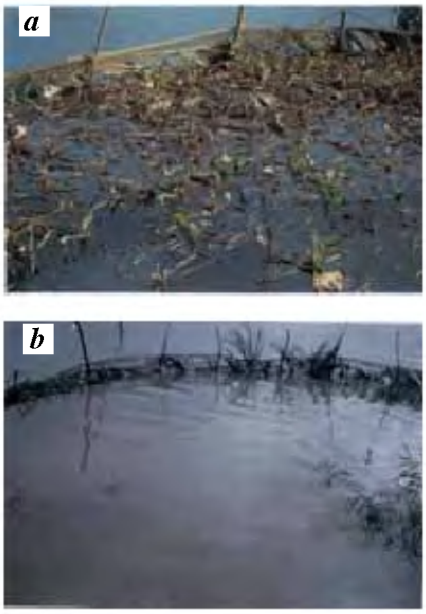

Figure 2. Effect of WP formulation on water hyacinth under field conditions. ***a***, Seven days after spraying, and ***b***, Two weeks after spraying.

experiment, the treatments were fixed for testing on water hyacinth plants maintained in troughs. Troughs of size 1 m × 1 m × 0.4 m were filled with mud and water collected from the lake where water hyacinth was noticed and 20 plants of uniform age were maintained. Cashew nut shell liquid (CNSL), a product of plant origin was also used to weaken the plants and to hasten killing of the weed by the fungus. The intensity of damage in each treatment was recorded based on a score chart and the index was worked out. Under glasshouse conditions, 97.78 and 82.22% damage was recorded by spraying 40% wettable powder (WP) @ 10 g/100 ml and 5 g/100 ml on 2% CNSL-sprayed plants respectively. When plants maintained in troughs were sprayed with WP, 32–46.67% plants were damaged. When CNSL alone was sprayed, the intensity of scorching ranged from 20 to 27.33%. However, when the formulation was applied @ 10 g/100 ml and 5 g/100 ml on 4% CNSL-sprayed plants, a marked increase in the disease intensity by 98.67 and 97.33% respectively, was observed (Figure 1).

The most effective concentration of WP @ 5 g/100 ml was tested on water hyacinth plants in Akkulam lake. The plants were sprayed with 5% CNSL @ 50 ml/m^2 and was allowed to dry for a period of 30 min and then sprayed with WP @ 5 g/100 ml and @ 50 ml/m^2. Higher concentration of CNSL (5%) was used in the lake as the water hyacinth plants were much more robust than under trough condition. The plants exhibited typical blighting symptom on the fourth day of spraying. The disease gradually spread from the leaves to the swollen petiole and by the seventh day, the plants started sinking to the bottom of the lake and the disease intensity ranged from 83.4 to 94.5% (Figure 2 *a*). Cent per cent control of the weed was achieved when the plants were sprayed with the formulation for a second time, two weeks after the first spraying (Figure 2 *b*). It was also observed that spraying of *F. pallidoroseum* (5% WP) and CNSL (5%) did not show any toxicity to the aquatic fauna and flora. The results of the present study clearly indicate that *F. pallidoroseum* is an effective biocontrol agent of water hyacinth. The efficiency of *F. pallidoroseum* could be further enhanced by pretreating the plants with CNSL at lower concentration, which is a product of plant origin easily available in Kerala. Also, *F. pallidoroseum* is not harmful to commonly cultivated plants or to the fauna found in the waterways. Work is in progress to evolve a technique to mass multiply the inoculum using cheaper substrate for large-scale field applications.

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Axillary shoot production in micropropagated date palm (*Phoenix dactylifera*)

Date palm (*Phoenix dactylifera* L.) is propagated traditionally by offshoots or suckers, which are produced in the leaf axils and usually appear at or below the ground level surrounding the stem base. Small offshoots that appear above the ground level on the trunk are usually destroyed due to difficulty in rooting. Offshoots are produced in a limited number for a certain period in the lifetime of a young palm tree. Offshoot formation is dependent on the genetic makeup of the cultivar and environmental factors. The number of offshoots produced by an individual date palm tree is highly variable and varies from one cultivar to another[1]. The traditional method of vegetative propagation through offshoot is slow, laborious, time-consuming and expensive[2-4]. Transmission of disease-causing pathogens and insects is another disadvantage of conventional offshoot propagation[3]. This has focussed on micropropagation technique during the past 20 years as