The Potential of Cercospora Rodmanii as a Biological Control for Waterhyacinths[1]

by

K. E. Conway and T. E. Freeman[2]

In 1971 a widespread decline of waterhyacinths (*Eichhornia crassipes* (Mart.) Solms) occurred in the Rodman Reservoir, a large impoundment of water near Orange Springs, FL. Large areas of the Reservoir infested with waterhyacinth became devoid of plants as diseased waterhyacinths eventually died and sank beneath the surface of the water. From 1971-74 the decline lessened in severity until the Spring of 1975 when the disease was again prevalent in the reservoir. In 1973 a *Cercospora* species was isolated from declining plants (Conway *et al.*, 1974). It was later reported as a new species, *Cercospora rodmanii* Conway, because of differences in symptomatology and conidial morphology from the previously reported *C. piaropi* Tharp, that also occurs on waterhyacinth (Conway, 1976a). The symptoms on plants in the reservoir during the initial decline were a chlorosis of the entire plant, spotted and tip-burned leaves, spindly petioles and root rot.

HOST SPECIFICITY DETERMINATION

In order to insure that *C. rodmanii* was a pathogen of only waterhyacinth, a host specificity determination was conducted on over 80 varieties of economically and ecologically important plants of Florida. A modified centrifugal (related plants) and varietal (economic plants) testing strategy was utilized to determine plants to be tested. Host specificity testing was also conducted on economically important plants of Louisiana prior to field testing in that state. The results from both greenhouse and field evaluations showed that the host range of *C. rodmanii* was limited to waterhyacinths and therefore could be employed in field tests with some degree of safety.

FIELD EVALUATIONS

Four field evaluations have been completed to determine the efficacy of *C. rodmanii* as a biological control for waterhyacinth. The following is a brief summary of each evaluation. Materials and methods have been published (Conway, 1976b).

LAKE ALICE

The first field test was initiated in Sept. 1974 in Lake Alice on the University of Florida campus, Gainesville, FL. (Conway, 1976b). A pool area (1.7 ha.) sperated from the main lake by a saw grass-cattail barrier was chosen for the test site due to its isolated location. A combination of mycelia and conidia (1 kg wet weight) of *C. rodmanii* was applied from the shoreline to a small area ($64.4m^2$) of waterhyacinth in the pool. The fungus was applied to those plants in this area only. Necrotic spots began to appear on the inoculated leaves of the plants within 14 da. A second spray was applied to the plants in the same area on Oct. 3, 1974 and more infection and damage was noted within 7 da. The presence of *C. rodmanii* was confirmed by reisolation from the diseased plants in the inoculated area. By Nov. 1, 1974, tip dieback and other symptoms were evident throughout the entire pool area. *Cercospora rodmanii* was isolated from diseased plants on the opposite side of the pool from the inoculated area to confirm the organism spread from the initial source of infection. An aerial view of the Lake on Nov. 21, 1974 showed a gradient of infection extending from the inoculated area through the pool area and into the main lake. Frost was first officially recorded in December and the diseased plants in the pool area were killed to the water surface. However, plants in the middle of the main lake continued to stay green. In Feb. 1975, regrowth of waterhyacinths was delayed longer in the pool area than in the main lake. The waterhyacinths in the pool were reinoculated in the spring of 1975 and disease symptoms and severity have been monitored since

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[2] Plant Pathology Department, University of Florida, Gainesville, FL 32611.

then with no additional inoculations.

Discussion: Conclusions from this field experiment are that *C. rodmanii* can infect waterhyacinth, and that once established can spread from a source of infection. In Lake Alice the disease has not been as devastating to waterhyacinth populations as it was during the 1971 decline of plants in Rodman Reservoir. The reason for this may be that Lake Alice is highly eutrophicated because it receives the sewage effluent from the University's secondary sewage treatment plant. This increased nutrition may impart a higher degree of immunity to the plants either through an increased growth rate or an altered metabolism.

LAKE CONCORDIA

A second field test was conducted in Lake Concordia, LA (June-Nov. 1975) and it was a large scale test to determine the effect of an integrated control of plant pathogens and insects on waterhyacinths. This was a cooperative effort of the Plant Pathology Department (our group) at the University of Florida with the Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS and the USDA Entomologist, Gainesville, FL. Plants were grown in 2m X 2m floating frames with screen bottoms. Two fungi were used, *C. rodmanii* and *Acremonium zonatum* (Sawada) Gams, applied at the rates of $48gm/m^2$ and $96gm/m^2$, respectively. These fungi were tested alone and in combination with two insects *Arzama densa* Walker (40 insects/frame) and *Neochetina eichhorniae* Warner (50 insects/frame). The test was monitored every two weeks and data on the weight of the plants in the frames, height of plants and number of flowers were recorded.

Discussion: Preliminary indications were that at rates applied little control was achieved using only one organism per frame. However, a significant reduction in the weight of waterhyacinths in the frames occurred when pathogens and insects were used in combinations of three and four.

GAINESVILLE INOCULUM RATE TESTS

A third test was located at Gainesville, FL and was in small containers ($0.4m^2$, surface area). The purpose of this test was to determine the effect of increasing inoculum rates of *C. rodmanii* ($24gm/m^2$, $48gm/m^2$, $96gm/m^2$) on disease incidence and damage to waterhyacinths. Ten plants with all dead leaves removed were placed in each container and the number of living leaves per container was recorded. The containers and treatments were arranged in a Latin square design. The fungus was applied by shaking comminuted mycelia and conidia onto the plants. Data were recorded every two weeks and included the number of plants, number of flower stalks, number of living leaves, number of dead leaves, and the length of the longest leaf and root per container.

Discussion: Results showed that an inoculum rate of $96gm/m^2$ significantly increased the number of dead leaves per plant. This inoculum rate will be the basic rate used in future field evaluations to determine if greater quantities of inoculum will create greater disease expression.

RODMAN RESERVOIR

The fourth test was located in Rodman Reservoir where the disease had been originally isolated. An area of waterhyacinth located behind Tree Population #4 near Paynes Landing was chosen because it was inaccessible to most boats and the intrusion by man was minimal. Five inoculations, one each at two week intervals, were applied to waterhyacinths from the shoreline starting on Feb. 28, 1975. A sixth application was placed (May 30, 1975) on waterhyacinth in the cypress tree area. It was felt that repeated inoculations were necessary to initiate infection and create an epiphytotic. By mid-April, damage to the plants due to *C. rodmanii* was evident in the inoculated areas. There was a definite reduction of plant growth and size in our plots when compared to uninoculated waterhyacinths that surrounded these areas. Also, for the first time in four years the disease was prevalent in the main reservoir near Orange Springs. In July, waterhyacinths in the inoculated areas were showing typical *C. rodmanii* symptoms and plants were beginning to decline, die and sink below the surface of the water. Water lettuce was invading many of these areas previously occupied by waterhyacinth. An aerial view on August 7, 1975 of the Tree Population #4 area showed continued infection and sinking of waterhyacinths with approximately 10-20 acres of open water. Large mats of waterhyacinths showed the typical *C. rodmanii* symptoms; small punctuate spotting on the leaves and petioles, necrosis of the leaf tips and root rot. By mid-October, the area of open water was estimated to be 30-40 acres with an additional 10-20 acres invaded by water lettuce. A reestablishment of open areas with 10-15 acres of waterhyacinth occurred over the winter. However, these plants were infected with *C. rodmanii* to control the growth of waterhyacinth deing the Spring of 1976. During June 1976, above average rainfall necessitated a change in the water flow patterns into the Reservoir which increased the inflow of more nutritious water from the eutrophic head lakes. This increased nutrition resulted in a more rapid elongation of the newly formed leaves of waterhyacinths which limited the disease to the lower canopy of the plants. However, the lower leaves were still heavily infected with *C. rodmanii* and during the early part of August foci of disease were noted in the Tree Population #4 area.

Discussion: Several significant facts concerning the efficacy of *C. rodmanii* resulted from the field test at Rodman Reservoir. It was shown that *C. rodmanii* spread from an area of infection and caused large areas of waterhyacinth to die and sink below the surface of the water. The organism was also capable of overwintering on the older leaves of waterhyacinth and provided an inoculum source to establish the disease during the next growing season. A complete elimination of the diseased plants would have prevented the continuation of the disease in the spring and this is a consideration that must be recognized in future aquatic plant management designs. The ability of *C. rodmanii* to control the growth of waterhyacinth depends on its ability to infect newly formed leaves. When all factors are optimal for infection the plant appears to put most of its energy into leaf production and as the pathogen kills the leaves the plant becomes depleted, declines and dies. The root area becomes more susceptible to invasion by rot producing microorganisms. The increased growth of waterhyacinths that occurred during the summer of 1976 also emphasizes the importance of an overall systems management approach that will favor conditions conducive to biological control agents.

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