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Controlling water hyacinth infestation in Lake Tana using Fungal pathogen from Laboratory level upto pilot scale

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Abstract

Eichornia crassipes is one of the most dangerous aquatic weeds for Lake Tana .To reduce its invasion biological, chemical and physical control methods can be used. Use of natural enemies of the weed to discourage its propagation is one of the best recommended options by scientific society. Among them, there are more fungi naturally a pathogen for water hyacinth and other plants. To use those patogenes to manage water hyacinth infestation in Lake Tana infected plant material by fungi were collected from three weredas (Amba Gyorgese, Dabat and Debarke) around Gondar since Novmber 2015. The collection was done from infected Faba bean leaves and roots. All isolated fungus was attempted to infect the collected healthy water hyacinth in laboratory and green house. Some of the isolated were show high moderate disease severity on the healthy water hyacinth. Disease severity scale was recorded .By following those experiments to show its efficiency, the effective pathogens on laboratory and green house were released to 16 m2 open ponds .In this study, we have recorded scientific data that shows the fungi were high potential to attack healthy water hyacinth at above 26 oc and at less than 25 % humidity.Finally, before directly release the fungi on Lake Tana its impacts were studied for a year by taking some aquatic plants and fish from the Lake. Fortunately, those fungi have not impact on some aquatic plant like Echinochloa and Cyperus papyrus grass, water quality and fish.

Keywords: Fungi; Eichhornia crassipes; Disease severity

Introduction

Lake Tana is occurred in the highlands of north-western Ethiopia.It is the country's largest freshwater body and the third largest lake in the Nile Basin. Also, it is the source of the Blue Nile, and its basin is one of the most important catchments in the Nile Basin[1] .The LakeTana basin has high significance to the economy and politics of Ethiopia. It also greatly influences the livelihoods of millions of people in the lower Nile Basin. Historically, there was a large area of Afromontane forest and many indigenous plant species in the Lake Tana basin; 172 woody species were observed in the basin, many of which were indigenous species [2]. There are also large areas of wetlands and seasonally flooded plains, which provide multiple services to the local community and serve as a home for many endemic bird species [1]. Lake Tana has a mean depth of 9 metre and maximum depth of 14 meter, length 78 kms and width of 68kms]3]. The basin (Lake Tana Basin and Nile Valley) was also the repositories of ancient indigenous culture, linguistics, history and ancient civilization. Some thousand years ago, science and technology in Medicine, Mathematics, Agriculture, Architecture, communication or writing system, commerce, etc.) were practiced in the Nile basin and it is assumed that the current world's technology is originated from the Nile basin and African rift valley [4]. The lake also balances the climatic condition of the region. The northern pick (i.e. Rase Dejene) and Lake Tana is the green belt which prevents the spread of the Sahara desert and offer wetter climates. The climate of the Eastern Afromontane Hotspot has been relatively constant over recent geological history due to high levels of biodiversity, endemism and thermo — coolant factors of the lakes and mountains [5]. In addition, the Lake supports hydro electric powers. In this regard, the lake plays a role to control environmental pollution. Hydropowers are most importantly clean energy sources with relatively negligible production of noxious gases or solid/ liquid wastes, and therefore the dam can largely.

As a Portuguese missioner Manoel de Al media in the early 17 centuries wrote in the center of Lake Tana 21 islands were exsit, among them seven to eight of which had monasteries. In most monstery,Ethiopian emperors and treasures of the Ethiopian Churchs were kept among them Dega Estifanose, Ura Kidane mihrit, Narga Selassie, Keberan Gabriel, Medhanelm of Rema, kota mar yam and Mertola maryam were found, also when the emperors become died their tombs are kept in those isolated monasteries among them Yekuno AMLA, Davit I, ZaraYaqob, Za Den gel.

Materials and Methods

The study areas were located in northern part of Lake Tana in Dembiya woreda, Gorgora at 1190SE12015'45'' N37018'11''E).

Healthy water hyacinth plants were collected from natural infestations of Lake Tana and maintained in a sterilized condition. Water hyacinth plants were kept in plastic pot filled with water and moisture containing sandy soil. In 250 ml Erlenmeyer flask, each contains 100 ml malt extract broth (MEB). were sterilized at 121 0C for 20 minutes and inoculated after cooling 7 - 10 day old cultures of isolated fungi. The inoculums spore suspension was incubated at 25 0C on rotary shaker for 5 - 7 days. The resulted 10 ml mycelium suspension were diluted by 20 ml of distiled water for each replicate, for three replicate 30 ml fungal suspension diluted with 60 ml of distiled water. For comparison of pathogencity, each suspension was then liberally applied to the surface of water hyacinth plants using a hand sprayer and all treated water hyacinth plant was covered by polythene tube sheet up to disease symptoms observed on leaf to minimize the disspercity across each other treated plants. Control plants were placed under the same conditions but without addition of the antagonists. Data collection commenced immediately disease symptoms appeared and continued weekly up to a five-week period. Plants with disease symptoms were recorded and scored to give disease incidence and severity. The disease incidence (DI) was taken as the percentage number of leaves on the plant that exhibited disease symptoms. This was measured by observing all the leaves of the inoculated plant in each pot and calculated as percentage of the total number of leaves on the plant. Disease severity (DS) was determined for each leaf on a scale of 0 to 9, where 0 = healthy, and 9 = 100 % diseased [21]. Values for individual leaves were summed and averaged to derive DS for a whole plant. Finally, isolates were categorized into five groups: "N," isolates that did not cause any significant damage or infection, "Mild," isolates that caused less than 25 % damage to the leaf area; "Low Moderate" isolates caused 26-50 % damage to the leaf area; " High Moderate," isolates that damaged 51-75 % of the leaf area and "Severe," fungi that cause greater than 75 % damage to the leaf area. 3.4. Data analysis Data was carried out using Statistical Package for Social Science (SPSS) version 16.0.

Results

Out of 230 isolating fungi from three districts, seven fungi species were affected the healthy water hyacinth in green house experiment. Those fungi were Tricothecium roseum, Aspergillus Flaves, Trichoderma spp1, Fusarium spp, Rhizocotonia spp, Aspergillus niger and Trichdoerma spp. The combined effect between the experment conducted season,soil composition which wre use for wraped the grild area of the steams and IBA concentration showed a good root initiation in the present study of air layer propagation technology .The treated stems of osyris lanceoleta with IBA 150 ppm initially showed root respond other than other treatmeants at 12 weeks of experiment. areas. The muddyand rocky area found along Dahanu and Tarapur coast are rich diversity of flora and fauna, most of which are fouling (sedentary) in nature. A lot of motile forms like crabs and amphipods are also found in concurrence with the macro fouling species. The biodiversity of macro biofoulers varies according to the certain physic-chemical factors like, temp, pH, O, BOD, nutrients, salinity etc. The present study showed significant variation in the physiochemical and biological parameters of the selected sites along Dahanu and Tarapur coast near Thermal and Atomic power plant. [10-13]. On the basis of disease severity (DS) the pathogenic species were divided into less than 25 % mild, low moderate isolates caused 26 - 50 % damaged of the leaf area, high moderate isolates that damaged 51-75 % of the leaf area and severely fungi that cause greater than 75 % damage of the leaf area. Of these species only Rhizoctonia spp (100 %) and Fusarium spp (78.6 %) showed high disease severity. These fungi were associated with a high percentage of tissue death after five weeks application. Aspergillus flaves, Tricothciumroseum and Aspergillus niger show high moderate disease severity (58.3 %, 56.4 % and 53.6 %) tissue death, respectively. Trichoderma spp2 (31.4.7 %) and Trichoderma spp1 (27.7 %) shows low moderate. Most isolates showed minimum lesion growth during the first week. Control plants not show disease severity.

Conrol Measures Of Biofouling

The simplest method for treatment of biofouling is simply to remove by mechanical cleaning eg, by treatment of the fouled surface with high-pressure water jets. TBT, Copper, UV irritation, Chlorination, Titanium alloy (2m/sec) and Silicone elastomers (for fast vessels) .Several kinds of natural antifouling agents that inhibit growth of fouling organisms have been isolated from marine organisms like bacteria, marine Algae.

Conclusion

Tricothecium roseum, Aspergillus Flaves, Trichoderma spp1- ,Fusarium spp, Rhizocotonia spp, Aspergillus niger and trichdoerma spp fungi were synergistically promising to minimize water hyacinth expansion at above 26 °C and at less than 25% humidity. Those fungi have not any impact on aquatic biodiversity of the Lake Tana. Because, most parts of the lake is thretened by water hyacinth in side of Dembeya, Maksegnete and Fogera dstrictes since this places of the Lake edge have accessed erosion soils because this erosion hold N and P nutrient.Since this nutrients make a good opportunity for spreads of water hyacinth, but the lake that surrounds by Bahrdar city have not observed this weed because it has not get the chance to get favorable nutrient source in the forms of agricultural run off. Therefore, in addition to applay the above mentioned fungi during the enviroment temprature above 26 °C to minimize the infestations of water hyacinth,also , if urbanization is expaneded in all Tana lake edges the lake will protected from any enviroment pollutanet since at the time internationally standardized buffer zone is established and the lake will never have a chance to connect with any enviroment pollutanet source.

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