ECOLOGICAL STUDIES ON PHYLLOPLANE FUNGI OF PADDY

Abstract

By

RAJEEVALOCHANA

THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENT OF THE DEGREE OF

DOCTOR OF PHILOSOPHY IN BOTANY

To

NORTH-EASTERN HILL UNIVERSITY
SHILLONG-793014
INDIA

SEPTEMBER, 1983

Microbial communities on the leaf surface of three varieties of paddy differing in resistance to the leaf spot pathogen, Helminthosporium oryzae, viz., Khonorullo (disease resistant), Ngoba (moderately susceptible) and Mirikrak (disease susceptible) were studied in detail using five different techniques of isolation (direct observation, moist chamber, leaf impression, washed leaves plating and dilution plate methods). The microflora of the phylloplane of the paddy plants is mainly influenced by varietal characters and also by the pathogen, H. oryzae. In addition, distribution of fungi on leaf surface was also dependent on leaf maturity and weather changes. Analysis of phylloplane mycoflora showed that in the resistant variety there was a significantly higher population of fungi as compared to the susceptible one. Further, the total number of fungal colonies was observed to increase significantly with the age of the plant and was independent of plant variety. Among the fungi isolated Cladosporium spp., Penicillium spp., Alternaria spp. and Aspergillus spp. dominated the leaf surface of both resistant and susceptible cultivars. Species diversity among fungal members as calculated by Sorenson's index was found to vary with plant age. A natural antagonism was found on the resistant varieties between Trichoderma viride and the leaf spot pathogen, H. oryzae.

From a study on the airspora of the three experimental plots where the paddy varieties were grown it was found that the fungal spores present in the air exerted a great

impact on the leaf surface of paddy. Most of the spores of air were also trapped on the leaf surface. Some of the forms however, maintained their specificity in the two environments viz., air and phylloplane. The spores of the pathogen were found in the air of all the three paddy varieties very early in the crop season but the visible symptom of the disease was observed later only on the leaf spot susceptible variety. T. viride, a possible antagonist of the pathogen was found only on the leaf surface of the resistant variety although it occurred in the air of all the paddy varieties.

Pathogenicity test was conducted by using Koch's postulates both in vitro and in vivo and it was confirmed that the causal organism for the disease occurring on the susceptible varieties was definitely Helminthosporium oryzae Breda de Haan which caused brown spot disease of paddy. This pathogen was also isolated in pure culture. The susceptibility to the pathogen increased with age which was clear from the pathogenicity studies done in vivo and in vitro. The pathogen spores from 15 day old cultures with a concentration of 2×10^5 spores/ml suspended in 0.01 M phosphate buffer at pH 6 if incubated at 35°C showed maximum spore germination and germ tube length.

From interaction studies done in vitro and in vivo between certain epiphytic fungi and the pathogen, it was observed that in vitro some selected fungal antagonists such

as Trichoderma viride may be used as a biological control agent forbrown spot disease of paddy although it was only partially successful in pot experiments. The exact mechanism of action of T. viride against the pathogen, H. oryzae could not be clearly understood. It can inhibit the pathogen either by hyperparasitism or by producing some antibiotics.

To see the competitive ability of some selected phylloplane fungi on the leaf surface of paddy varieties, spores of these fungi were germinated in leaf leachates, leaf extracts and on detached leaves of paddy and their growth performance was studied. The sampling for the experimentation has been done at young, mature and senescent stages of paddy varieties. The effect of the different treatments on the germination and growth performance of the fungi varied in the different experiments. Generally, the germination and growth performance of these fungi were enhanced in the leaf leachates, leaf extracts and on the surface of leaves independent of variety. But most of the antagonistic fungi of the pathogen such as T. viride were more stimulated in the leaf leachates, extracts and on the leaf surface of resistant varieties than on the susceptible one while the susceptible variety leachates, extracts and leaf surface stimulated the spore germination of the pathogen.

The results of the biochemical analysis of the leaf leachates indicate that eighteen amino acids, sixteen sugars,

twelve organic acids and nine phenols were recorded in leaf leachates of the three paddy varieties. The number of amino-acids, sugars, organic acids, and phenols increased as the plants grew older and more amino acids, sugars, organic acids and phenols were detected in the exudate of the resistant variety. The quantitative study of leaf extracts also indicate that more quantity of sugars, amino acids and phenols were detected in the resistant variety than in the susceptible one and the amount increased with plant age. The results of the biochemical analysis of the leaf leachates and extracts clearly confirm the fact that the colonization of fungi on the leaf surface is directly controlled by nutrient level of the leaf surface which changes with the release of substances from the leaf. In addition to high nutrient level in the resistant variety which enable this habitat to attract more saprophytic fungal colonization thereby forming a microbial barrier to foliar infection, some phenolic compounds may also provide resistance to the plant to brown spot disease of paddy.

Another factor which favours the development of saprophytes on older leaves during crop growth was found to be pollen. The presence of pollen on surfaces of leaves had marked influence on phylloplane fungal population. The total fungal population was highly stimulated on leaves with pollen especially on mature leaves and the effect was much pronounced on the leaves of resistant variety. In addition to change in

saprophytic flora the pathogen population also increased in the presence of pollen on the leaves of susceptible variety. This study suggests a possible role of pollen in pathogenesis and disease development.