CIAT
Centro Internacional de Agricultura Tropical

SEMINARIOS INTERNOS



SE-15-83
December 2, 1983



# GENETIC RESISTANCE AS A COMPONENT FOR RICE BLAST MANAGEMENT

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Many scientists in different disciplines have investigated the rice blast over the last two decades. Yet rice blast remains one of the major rice diseases. Although damage and control cost vary from one place to another or from one season to another, no rice variety is grown in blast-prone areas without the help of fungicide.

In an agroecosystem, disease level is determined by a dynamic interaction of various factors in a given crop season. Often, the inherent bio-physical crop environment predominantly influences the level of infection as exemplified by frequent and severe outbreaks of rice blast in drought-striken upland conditions. The rate of nitrogen application, planting density, and chemical application are the most flexible variables for blast management. Yet ever-increasing production costs, stabilized rice price and rapid expansion of rice planting in blast-prone areas still force consideration of the use of genetic resistance as a component of blast management in spite of its repeated failure in the past.

The type of genetic resistance to rice blast can be classified as qualitative resistance based on absence or presence of sporulating lesions or as quantitative resistance based on disease severity. Although many rice cultivars possess both qualitative and quantitative resistance, they differ in terms of spectrum of qualitative resistance and also level of quantitative resistance. Distinction between these two types of resistance is not always simple, particularly under field conditions. Often cultivars with broad spectrum qualitative resistance behave as those with a high level of quantitative resistance and vice versa.

Qualitative disease evaluation methods are many and common. It is relatively easy, provided with basic facilities and preparation. Quantitative disease evaluation methods, on the other hand, are rather complicated and laborious. Simple but promising new quantitative evaluation methods have been devised both for segregating generations and advanced generations. The relative evaluation system (RES) was developed and utilized for selection of slow-blasting lines. RES is base on a common observation that human eyesight is relatively good at comparison (i.e., equal to, less than, or more than) but rather poor in quantification. RES is suitable for breeders since their main interest is not the absolute amount of damage but the relative performance of certain plants or lines as compared to reference materials or local checks.

Using the new evaluation methods several promising slow-blasting lines were selected from three F2 populations derived from crosses between CICA 4, a common susceptible parent with low quantitative resistance, and three cultivars known to possess high level of quantitative resistance: namely Tapuripa, Camponi and IR 11-452-1-1. A large proportion of apparently disease-free plants (no-infection type) under field conditions in previous generations showed low quantitative resistance in subsequent generations. Plants demonstrated apparently high and intermediate quantitative resistance in F4 further segregated widely but less than the no-infection type, while the majority of plants evaluated as having a low level of quantitative resistance in F4 maintained the same reaction in F5.

A modified bulk breeding method appears to be better than pedigree method to select plants with high or intermediate level of quantitative resistance. The results also strongly suggest that negative selection, selection against high susceptibility, should be made rather than positive selection, selection for apparently disease-free plants with less amount of disease to obtain a higher level of quantitative resistance. This implies the importance of proper planting time, plot design, plot management and use of diversified inoculum to insure not only good disease level but also elimination of masking effect of quantitative resistance over low level quantitative resistance.

Given the observation of dynamic shifts in race composition in natural pathogen populations, the invariably unstable performance of genetic resistance of improved, high yield rice varieties has been considered as an uncontrollable natural consequence. But the attempt to obtain genetic resistance which would be stable has been continued. Any genetic measures which will not allow a unindirectional shift of the blast pathogen in terms of pathogenicity, increase in virulence, or amount of inoculum would lead to stability of varietal performance to rice blast. Known genetic methods to manage rice blast can be grouped into two basic categories: 1) methods that aim to prohibit the perpetuation of rice blast pathogen in rice plants, and 2) methods that accept the coexistence with rice blast pathogen but without allowing significant economic yield losses. Several methodologies have been devised to estimate the stability of genetic resistance. Multilocation evaluation is one practical method, but the selection of testing sites should be made based on reliable information on pathogenicity pattern of the blast pathogen in each site. Diversification of inoculum in a testing site, or use of race-specific nursery developed by pathology unit is another option for predicting stability.

Physiological or architectural characters of the rice plant which might indirectly influence blast development should be further investigated. Particularly those characters such as vigorous regrowth of plants after a long dry spell and severe leaf blast, or stem elongation well above the leaf canopy level could be considered as advantageous characters in a given region.

It is not difficult to find that resistance breeding for rice blast is one of the popular breeding objectives of any rice improvement project. Many pages of research reports are dedicated to the topic of rice blast. Nonetheless past history clearly indicates that blast resistance breeding still remains a wish rather than a solid achievement. The CIAT/ICA Rice Program in the last 13 years is no exception as evidenced by its experience with a series of CICAs.

Reviewing the breeding activities of any rice program, it is rather surprising to note that very little attention has been paid to the improvement of evaluation methods, and thus selection procedures. Almost no research effort or attempt has been made to adopt or improve selection procedures, a crucial step in breeding, while much of the emphasis has been given to discussion on strategies and corresponding hybridization plans. Therefore, the pathology unit of rice program in the past five years has made its major effort to developing a practical evaluation methodology suitable for blast resistance breeding and has conducted related researchers. A successful blast resistance breeding project requires not only deliberately designed crossing plans but also properly designed screening and validation procedures developed by continuous basic research.

In conclusion, more emphasis should be given to the development and vigorous application of "quality control procedures" in blast resistance breeding process: i.e., selection procedures and verification phase of breeding, before making our technical products- "improved blast resistant high yielding variety" - available to our customers. This requires not only simply a group of scientists but also patient and openminded cooperation among team members, regardless of concept and experience of individual, whith consistant and unbiased administrative support and coordination. Now it is time that we should have high sense of responsability with regard to the quality of products and consequences of the use of such products.

Science is not a religion and more than a concept. It should be a religious effort to prove scientifically that what we are thinking and doing is right and valid. Thus the development of genetic resistance to manage rice blast more efficiently and economically still remains as our formidable future scientific challenge.