MARUMEGH

Kisaan E- Patrika

Available online at www.marumegh.com

 ISSN: 2456-2904

RESISTANCE FOR STRIPE RUST DISEASE

Rizwana Rehsawla[1], Anu Naruka[2], Vivek Singh[2], Rumana Khan[3] and Vijay Sharma[4]

[1]Department of Molecular Biology, Biotechnology and Bioinformatics, CCS Haryana Agricultural University, Hisar

[2]Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar

[3]Department of Genetics and Plant Breeding, Rani Lakshmi Bai Central Agricultural University, Jhansi

[4]Department of Genetics and Plant Breeding, Banda University of Agriculture and technology, Banda

Email: anunaruka8@gmail.com

`Modern agriculture is facing serious problems due to the attack of disease causing pathogens. Most of the crops today are grown in very dense populations compared with primitive production practices. For example, wheat is grown in a dense canopy. So, to secure the urgently needed high yields, crops must be protected by all possible means from the pathogens and other diseases. Basically for disease resistance breeding represents the most important way to counteract the pathogens. However, more efficient methods and new approaches are needed for producing resistant crop varieties. Yellow (or stripe) rust caused by *Puccinia striiformis f. sp. tritici* is a devastating disease of wheat worldwide. The air born dispersal of spores from one field to another and even in longer distance and the ability of pathogen to mutate and multiply makes this disastrous.

Various discoveries in the field of plant pathology lead to the wheat improvement strategies. In (1905) Biffen discovers genetic resistance, Stakman and Levine (1922) discover, physiological specialization in rusts, and Flor (1956) has discovered gene-for-gene interaction. According to gene-for-gene interaction for every resistance gene that is present in host there is corresponding avirulence gene present in pathogen. The hypersensitive (race specific) type of resistance has predominated in wheat improvement. This kind of resistance is also known as vertical resistance. At the level of vertical resistance, one gene can provide high degree of resistance to the plant that addition of one or more genes will not have a significant effect on the phenotype. A plant variety that exhibits a high degree of resistance to a single race, or strain, of a pathogen is said to be vertically resistant. Vertical resistance is temporary resistance in agriculture. When a matching strain of the parasite appears, the resistance fails in every host individual of that crop and, shortly afterwards, of that entire cultivar. Contribution of the additive variance to the total genetic variance is then negligible. When loss of effectiveness of genes, or their combinations takes place, it led scientists to switch for alternative approaches to resistance management. Horizontal resistance functions equally against most strains of the parasite. Consequently, it cannot fail to the extent that vertical resistance fails. It is durable resistance. It is the resistance that invariably occurs in the absence of vertical resistance. Autoinfection by an asexually reproducing parasite is a matching infection, and the consequences of a matching infection, including all auto infections, can be controlled by horizontal resistance only. The race non-specific or horizontal resistance was widely used in breeding for stripe rust resistance by Caldwell (1968). This type of Application in breeding for stripe rust resistance is known as slow rusting. Among the various strategies to fight against stripe rust pathogen economic, efficient, and environment-friendly approaches are required to eliminate the use of chemicals such as fungicides and minimize the losses due to stripe rust in wheat. Several *Yr*-genes that confer resistance to stripe rust in wheat have been identified and deployed into commercial wheat cultivars. But due to the race specific nature of these genes a shift in virulence and emergence of new pathotype render the majority of yr genes susceptible. For example in 1996, one of the most important Yr resistance gene known as *Yr*9 became susceptible by the emergence of new pathotype 46S119. In 2001 other new yellow rust rustpathotype 78S84 emerged and make 46S119 susceptible and also had additional virulence on *Yr*27, make most popular mega-wheat variety PBW 343 susceptible. The evolution of new virulence make this type of resistance short term and it lasts very rapidly. On the other hand non- race-specific is polygenic and effective at the adult plant stage, this type of resistance has often been known as slow rusting or partial resistance. It is long- lasting and more durable. Out of the 61 *Yr* genes far, only nine genes *Yr*18, *Yr*29, *Yr*30, *Yr*36, *Yr*39, *Yr*46, *Yr*48, *Yr*49 and *Yr*52 are associated with durable resistance . These genes delay the process of infection, slow down the progress of disease but do not provide the host plant with complete protection.

The most economical and environmentally friendly strategy to be applied against stripe rust is the genetic resistance. The two major types of resistance which are explained against the stripe rust are All-stage resistance and adult-plant resistance (APR). In the seedling stage All-stage resistance is detected and it provides resistance throughout the plant's growth stages. This kind of resistance is typically race-specific and qualitatively inherited and usually expressed at high levels. Virulent races in the pathogen population can be overcome resistance due to strong selection pressure. On the other hand APR can be race specific or race nonspecific and it expressed during later stages of plant development and race-nonspecific resistance is often durable, quantitatively inherited and provides partial or slow-rusting resistance. High temperature adult-plant (HTAP) resistance is a type of APR that requires high temperature for plants to express resistance. As the plants grow old and temperature raise, the HTAP resistance becomes effective. It is non-race specific and durable resistance. It itself express in the late jointing stage and do not provide complete protection against disease. Through the transcriptomics different genes were found and analyzed that are involved in all stage/HTAP resistance. Among the permanently named resistance genes, *Yr*11, *Yr*12, *Yr*13, *Yr*14, *Yr*16, *Yr*18,*Yr*29, *Yr*30, *Yr*34, *Yr*36, *Yr*39, *Yr*46, *Yr*48, *Yr*52, *Yr*54, *Yr*59, and *Yr*62, confer adult plant or high temperature adult plant (HTAP) resistance genes, whereas the others confer all-stage resistance. Replacement of highly susceptible crop varieties with locally adapted resistant varieties possessing a combination of effective all-stage and adult plant resistance. More than 70 officially named stripe rust resistance genes and many unofficially named genes or quantitative trait loci (QTLs) have been identified and mapped to specific wheat chromosomal locations. Effective resistance genes can be deployed in breeding programs to produce wheat cultivars with APR and/or combination of all-stage resistance to wheat rust. Exploitation of known resistance in local and global breeding materials with the help of marker assisted selection has facilitated efficient breeding for resistance.

References:

Goutam, U., Kukreja, S., Yadav, R., Salaria, N., Thakur, K., and Goyal, A. K. (2015) Recent trends and perspectives of molecularmarkers against fungal diseases in wheat. Front Microbiol. 6:861

McIntosh, R. A., Dubcovsky, J., Rogers W. J., Morris, C., Appels, R. and Xia X. C. (2013) Catalogue of gene symbols for wheat: 2013–2014 Supplement (http://www.shigen.nig.ac.jp/ wheat/komugi/genes/macgene/supplement2013.pdf).