Searching for Stem Rust Resistance Genes in Pakistani Wheat

Although, stem rust fungus can be controlled by spraying chemical fungicides in the short run, this is not an environmentally friendly approach. Moreover, fungicides add to the cost of production and, therefore, are likely to lower farmer’s income. Hence, identifying resistance genes effective against the prevalent races of stem rust fungus and incorporating these genes into adapted wheat varieties is the only sustainable approach to safeguard global wheat production in the long run. Conventional methods of gene identification require time and controlled environmental conditions and also involve the risk of pathogen escape. However, these shortcomings can be overcome by the use of DNA markers, which are short DNA fragments that may be located in close proximity with genes of interest. The presence/absence of specific genes can be determined from the presence/absence of these markers in a variety.

To date, DNA markers closely located with more than 50 stem rust resistance genes (Sr) have been identified and subsequently validated. However, there are limited reports in Pakistan on the detection of Sr genes in wheat using DNA markers. Therefore, researchers conducted a study to detect major Sr genes in Pakistani wheat varieties in order to assist the development of rust-resistant wheat varieties in the future with the help of DNA markers. Results were reported in the November–December 2012 issue of Crop Science.

In the study, 117 Pakistani wheat varieties were screened with 18 DNA markers to detect the presence of eight Sr genes (Sr2, Sr6, Sr22, Sr24, Sr25, Sr26, Sr31, and Sr38). Genomic DNA of all varieties and the control varieties (which possess or lack the Sr genes) was extracted using standard protocol. The particular DNA fragments associated with the presence/absence of Sr genes were amplified (copied in large number) using the DNA markers and the polymerase chain reaction (PCR) procedure. The amplified DNA fragments were separated according to their sizes in an agarose gel by running an electric current in it. The agarose gel was stained with ethidium bromide, which enabled the detection of DNA fragments under ultraviolet light in a Gel Documentation System.

The study revealed that Sr genes effective against Ug99 (Sr22, Sr24, Sr25, and Sr26) were absent from all Pakistani varieties studied, whereas Sr genes Sr2, Sr6, Sr31, and Sr38 were present at various frequencies. The highest frequency was observed for Sr2 (9–79% by different markers), followed by Sr31 (35%), Sr6 (11%), and Sr38 (9%). The research findings indicated that Pakistani wheat varieties possess very few Sr genes and lack resistance genes potentially effective against new stem rust races. Hence, there is a need to incorporate Sr genes into Pakistani wheat varieties. Additionally, different markers used for adult plant resistance gene Sr2 indicated different frequencies of this gene in the tested varieties. The authors conclude that more reliable and efficient markers need to be developed for marker-assisted selection of this and other genes. They believe this study may help wheat breeders in the development of wheat varieties with improved stem rust resistance in Pakistan.
