Co-evolution of breeding strategies and cropping systems for raising wheat yield potential on stressful environments

Pedro Luiz Scheeren[1], Vanderlei da Rosa Caetano[2]

[1]Embrapa Trigo, Rodovia BR 285, km 294, PO Box 451, CEP 99001-970, Passo Fundo, RS, Brazil. [2]Embrapa Clima Temperado, Rodovia BR 392, km 78, PO Box 403, CEP 99010-971, Pelotas, RS, Brazil. Email: scheeren@cnpt.embrapa.br

The average annual wheat area in Brazil has been around 2 million hectares during the last 10 years. Ninety percent of the wheat area and yield is concentrated in the states of Rio Grande do Sul and Paraná (Climate Regions Cfa and Cfb). About 95% of the cropping area in these states is under no-tillage. The average wheat yield is about 2.200 kg ha^{-1} in rainfed areas and over 5.000 kg ha^{-1} in irrigated areas. Less than 2% of the Brazilian wheat growing area is sown under irrigation, in the Cerrado Region. Most of the wheat area is cultivated with modern cultivars and less than 1% is sown with wheat landraces. Since 1925, the Brazilian wheat breeding programs released more than 450 cultivars for the different environments. The current abiotic constraints are: low rainfall (drought) and heat stress in the Cerrado region, and lodging, frost damage and pre-harvest sprouting in Southern Brazil. The most important diseases are: leaf rust (*Puccinia triticina*); scab (*Fusarium graminearum*); mildew (*Blumeria graminis*); glume blotch (*Stagonospora nodorum*); tan spot (*Dreschlera tritici repentis*); spot blotch (*Bipolaris sorokiniana*); wheat blast (*Magnaporthe orysae*); and virus diseases (BYDV and SBMV). Considering these constraints, the need for genetic progress is very challenging. The next generation of crop innovations in wheat and other crops can only be achieved by using the best scientific information, which means conventional breeding, advanced breeding and biotechnology. In 1978, in Southern Brazil, besides the conventional breeding strategies, a new methodology, called systemic breeding, was initiated. In this approach, selection is done on a large number of crosses (thousands of crosses per year), in the first generations. The approach was improved by applying multiple stress selection on F1s and complex F1s (cross of F1/F1), instead of beginning the selection in F2 populations. Such approach could also be suitable for breeding programs in underdeveloped countries, because it does not need high investments. Artificial stresses and pathogen inoculation were used in order to obtain fast solutions on several selected characteristics. Plant ideotype and bread wheat quality traits were also important goals. The first results of the new approach were breeding lines with a set of combined desirable traits. Cultivar BRS Parrudo was released in 2012. It presents a good plant ideotype, has a set of resistances to diseases, high yield potential and high gluten strength.