

ABSTRACT

Human society is at a critical juncture as climate change becomes more real and inevitable. The global effects of climate change are unprecedented. Hence rising and fluctuations in temperatures undermines food production, causing glaciers to melt, disastrous flooding and erosion. Particularly in Pakistan changes in monsoon seasons and increased temperatures are likely to bring considerable challenges to the agricultural sector, where vulnerability to climate change is already high. Sustainable wheat production is continuously threatened by recent climatic change. Drought and rusts are the major stresses in rainfed areas of Pakistan which causes 30-40% yield losses. The recent high temperature in fall season, terminal heat stress and change in virulence pattern of rust diseases is the result of climate change. This alarming situation invites enormous efforts for diversification of the genetic base of the current Pakistani wheat germplasm to develop climate resilient and disease resistant varieties for sustainable production of the wheat in the country. In this regard the Wheat Program, NARC, Pakistan initiated an intensive breeding program. Diverse sources of resistance to the three rusts (i.e. Yellow rust, Leaf rust & Stem rust) particularly to the stem rust race Ug99 and abiotic factors like drought and heat tolerance were introduced from CIMMYT and ICARDA. Through standard breeding procedures, seven rust resistant wheat varieties (NARC 2009, NARC 2011, Pakistan 2013, Zincol 2016, Borlaug 2016, Markaz 2019 and NARC Super) have been released. These varieties are also resistant to Ug99. The varieties i.e. NARC 2011, Borlaug 2016, Zincol 2016 and NARC Super are performing well in irrigated areas. NARC 2009, Pakistan 2013 and Markz-2019 are drought tolerant and are suitable for rainfed conditions. The variety Zincol 2016 has high Zn content (35 ppm) in grain as compared to national standard check variety (25 ppm). These varieties are not only higher yielding but also possess good grain quality and other desirable traits. Thus these varieties with diverse sources of resistance and adaptation will replace the old susceptible varieties and reduce the risk of rust threat to exploit the potential yield and increase wheat production in the country. A considerable quantity of seed of these varieties is already present in the national seed system for quick dissemination.

INTRODUCTION

Like other countries of the world, in Pakistan sustainable wheat production is also continuously threatened by a number of biotic and abiotic stresses. Pakistani wheat varieties are facing constant threat from continuously evolving new pathogen races of rusts as well as drought. Wheat varieties resistant to the prevalent races of rusts need to be developed in order to avoid yield losses in future. In addition, the impact of recent climatic change on sustainability of wheat productivity cannot be ignored. The hot and dry regions might have negative impacts of climate change. The underdeveloped countries expected to be affected more due to less precipitation and rise in temperature. Furthermore, the fluctuation in precipitation and temperature might be unexpected. The recent high temperature in fall season, terminal heat stress and change in virulence pattern of rust diseases is the result of the climate change. Continuous evolving of new pathogenic races and degradation of natural resources and mainly climate change in form of fluctuation in temperature regimes and rainfall pattern are constant threats to sustainable wheat production in the country. Hence enormous efforts are needed to diversify the genetic base of the existing Pakistani wheat to develop climate resilient and disease resistant varieties for sustainable wheat production in the country. To meet the challenge of improving wheat productivity in the country, Wheat Program-NARC, Islamabad Pakistan adopted a smart breeding approach to developed climate resilient and rusts resistance spring wheat varieties with a short time. The newly released varieties will complement the existing diversity and the farmers can make decision to choose and pick the higher yielding variety with resistance against rusts. In this way, the individual farmer will gain the optimum benefit.

METHODOLOGY

Keeping in view the present scenario of Pakistan, Wheat Program, National Agricultural Research Center, Pakistan initiated an intensive breeding program for early release of varieties. Diverse sources of resistance to the three rusts particularly to the stem rust race Ug99 and tolerant to abiotic factors like drought and heat tolerance were introduced from CIMMYT and ICARDA. Wheat Program NARC evaluated this material through standard breeding procedures. Initial screening was conducted at the National Agricultural Research Center (NARC), Islamabad, under rainfed conditions with two replications arranged in 5 by 5 blocks in alpha lattice design as described by Patterson and Williams (1976). Evaluation of selected lines of wheat generally conducted at several levels involving initial evaluation at experiment stations, adaptability testing of selections at multi-location yield trials followed by Provincial Uniform Wheat Yield Trials. Final evaluation or pre-release testing of potential candidate varieties is carried out in the National Uniform Wheat Yield Trials (NUWYT) for two years. This Trial is primarily concerned with the final testing phase of the evaluation program particularly the analysis and collection of data required to justify variety release and support subsequent recommendations for general cultivation in the different agro-ecological zones of the country. Data relevant to the commercial purpose of both producers (yielding ability, disease resistance and agronomic performance) and consumers (product quality) were reviewed. The technique of stratified ranking (Fox et al. 1990) used to test yield stability.

RESULTS

As result of intensive breeding program, six rust resistant wheat varieties (NARC-2011, Pakistan-2013, Zincol-2016, Borlaug-2016, Markaz-2019 and NARC Super) have been released. The salient features of the varieties are given in following table:

Variety	Yield Potential (Kg/ha)	Salient features	Adaptability	Parentage	Approved by
NARC Super	6900	<ul style="list-style-type: none"> ➤ It carries resistance against yellow rust, leaf rust and stem rust race Ug99. ➤ It has high protein content (13.7 %) and test weight (79 kg/hl). ➤ It is a medium maturing wheat variety. 	Irrigated Area of Punjab	MUTUS*2/HARIL #1	Punjab Seed Council - 2021
Markaz - 2019	6800	<ul style="list-style-type: none"> ➤ It displays resistance against yellow rust, leaf rust and stem rust race Ug99. ➤ It has high protein content (15 %) and test weight (78.7 kg/hl) ➤ It is a medium maturing wheat variety. 	Rainfed area of Punjab	SOKOLL//FRTL/2*PIFED	Punjab Seed Council - 2019
Borlaug - 2016	7000	<ul style="list-style-type: none"> ➤ It carries APR against all three rust diseases particularly to stem rust race Ug99. ➤ Protein content = 12.7% ➤ It is a medium maturing wheat variety. ➤ It has better adaptability for late sowing. 	Irrigated Area of Punjab	SOKOLL/3/PASTOR//HXL7573/2*BAU	Punjab Seed Council - 2016
Zincol - 2016	6500	<ul style="list-style-type: none"> ➤ It has high Zn content (35 ppm) in grain ➤ It displays resistance to yellow, stem and leaf rust, particularly to stem rust race Ug99. ➤ Better adaptability for late sowing to fit in the cropping pattern. ➤ Protein content – 12% ➤ It is a medium maturing wheat variety. 	Irrigated Area of Punjab	OASIS/SKAUZ//4*BCN/3/2*PASTOR/4/T.SPELTAPI348449/5/BAV92/3/OASIS/SKAUZ//4*BCN/4/PASTOR/6/WBLL1*2/CHAPIO	Punjab Seed Council, 2016 KP Seed Council - 2018
Pakistan - 2013	7000	<ul style="list-style-type: none"> ➤ Resistant to leaf rust, yellow rust & stem rust race of Ug99 ➤ Protein content = 12% ➤ It is a medium maturing wheat variety. 	Rainfed area of Punjab	MAX94.27.1.20/3/SOKOLL//AT TILA/3*BCN	Punjab Seed Council, 2013
NARC-2011	6500	<ul style="list-style-type: none"> ➤ Resistant to yellow, stem and leaf rust and stem rust, particularly stem rust race Ug99. ➤ Has better response to high in put. ➤ Has better adaptability to Southern Punjab and Sind province. ➤ Protein content =12 % ➤ It is a medium maturing wheat variety. 	Irrigated area of Punjab	OASIS/SKAUZ//4*BCN/3/2*PASTOR	Punjab Seed Council 2011

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