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Breeding of wheat genotypes for the semidwarf character and high grain yield.

Wheat is the basic staple food for most of the population and largest grain source of the country. The importance of wheat is always recognized when formulating agricultural policies. Wheat contributes 12.5% to the value added in agriculture and 2.6% to GDP. Wheat was cultivated in an area of 8.666 x 10^6 ha in 2011–12 (Table 1), a decrease of 2.6% over last year when the area of 8.901 x 10^6 ha. A production of 23.5 x 10^6 is estimated in 2011–12. The yield/ha posted a negative growth of 4.2% compared to 11% last year, which is due to the fact that sowing was delayed because of standing water and other climatic factors.

Table 1. Area, production, and yield of wheat grown in Pakistan between the 2007–08 and 2011–12 crop years (Source: Pakistan Economic Survey (2011–12).

Year	Area		Production		Yield	
	x 10^6 ha	% change	x 10^6 ha	% change	x 10^6 ha	% change
2007–08	8.550	–0.3	20.959	–10.0	2.451	–9.8
2008–09	9.046	5.8	24.033	14.7	2.657	8.4
2009–10	9.132	1.0	23.311	–3.0	2.553	–3.9
2010–11	8.901	–2.5	25.214	8.2	2.833	11.0
2011–12	8.666	–2.6	23.517	6.7	2.714	–4.2

Progress of cultivar NIA-Sunhari. A total of 5,000 kg of NIA-Sunhari pre-basic seed was produced from three acres during 2011 out of which 2,500 kg seed sold to growers and seed companies during 2011–12.

Candidate varietal material. Two candidate cultivars (NIA-22-03 and NIA-54-03) are being maintained for sending as entries to National Uniform Wheat Yield Trials (NUWYT).

Zonal Trial studies. Two genotypes (NIA-6-12 and NIA-CIM-04-10) were tested in zonal/regional trials in the Sindh province. The performance of NIA-CIM-04-10 was comparatively better for grain yield (kg/plot).

Trial I. This trial was conducted with 14 advanced lines with two check cultivars, NIA-Sunhari and Kiran. The trial was sown on 2 November, 2010. The trial had six rows of each genotype with a 4-m row length in three replicates. The results indicated that line (01) had the highest grain yield/plot (2.52 kg). Possible reasons could be that the line also had a

higher number of spikelets/spike and increased main spike grain yield. Subsequent lines that had higher grain yield were 03 (2.37 kg), 08 (2.4 kg), Kiran (2.32 kg), 12 (2.23 kg), 11 (2.20 kg), and 02 (2.18 kg). Line 10 had the lowest grain yield (0.983 kg), possiblally because ths line possesses the lowest number of grains/main spike.

Trial II. This trial consisted of 16 genotypes including the two check cultivars NIA-Sunhari and Kiran. The trial had six rows of each genotype with a 4-m row length in three replicates. Sowing of the trial was completed on 2 November, 2010. The results showed that line 09 had the highest grain yield/plot (2.75 kg). Subsequent lines that had higher grain yield were Kiran (2.70 kg) and line 02 (2.65 kg). The possible reasons for higher grain yield in Kiran and line 02 could be due to increased main spike grain yield. Line 05 (1.65 kg) had the lowest grain yield per plot compared with other lines and cultivars.

Trial III (Isoline material). Thirty-six genotypes of isogenic material for Norin-10 (*Rht1*, *Rht2*, *rht*) were sown on 3, November, 2010. The trial had six rows of each genotype with a 4-m row length of four meters in three replicates. In this comparison, line 03 (2.433 kg) had the highest grain yield/plot. Subsequent lines with a higher grain yield were 17 (2.400 kg), 28 (2.383 kg), 26 (2.333 kg), 19 (2.283 kg), 30 (2.250 kg), 18 (2.233 kg), and 2 (2.217 kg). Line 08 (0.750 kg) had the tallest plant height with the lowest grain yield due to lodging.

Mutation breeding for drought tolerance. The material for drought consisted of 72 M_4 genotypes planted with two 4-m rows in three replicates. Lines 62 and 63 had produced the highest grain yield (388 g/plot) under zero/no irrigation. Line 64 had produced the highest grain yield (542 g/plot) under two irrigations. Line 58 had produced the highest grain yield (542 g/plot) under full irrigation conditions. Line 64 had also produced the highest grain yield (461 g/plot) average performance over three irrigation treatments.

Salinity tolerance. The salinity of soil ranged from 3.1 to 11.4 EC (1:2.5) ds/m. The same 72 M_4 progenies used for the drought studies also were grown in a saline soil. Line 9 (330 g/plot), from mutated progenies of the cultivar Bhittai, had the highest grain yield/plot than that of all other genotypes and check cultivars. Subsequent lines derived from Bhittai that had a higher grain yield were 17 (245 g), 15 (233 g), 30 (230 g), 10 (225 g), and 22 (215 g). The mutated line 10 (270 g) derived from the cultiar Kiran, had the highest grain yield/plot. Subsequent lines with higher grain yield/plot from the cultivar Kiran were 5 (237 g) and 23 (215 g). The Kiran check had 202 g grain yield/plot. Thirty mutant progenies were selected for next M_5 generation.

Mutation studies under normal conditions. The 72 mutated M_4 progenies used for drought studies also were grown in normal soil conditions. The lines that produced highest grain yield/plot were 14 (428 g), 15 (425 g), 21 (440 g), and 27 (437 g) from the cultivar Bhittai. However, the maternal Bhittai parent had a plot grain yield of 328 g. Lines that had the highest grain yield/plot were 11 (588 g), 15 (563 g), and 17 (588 g) from the cultivar Kiran. However, the maternal Kiran parent had a comparatively lower grain yield/ plot (430 g).

Introduction of *Rht8*. The semidwarfing gene *Rht8* was transferred from the Italian cultivar Mara. The material is in the F_5 generation.

Breeding material. The breeding material consisted of three crosses F_1 generation, four crosses from the F_4 generation, two crosses from the F_7, one cross from the F_8.

Germ plasm material. We are maintaining 140 lines with different characteristics for use in the crossing program.

Sanction of a new international project. A new IAEA/RCA/RAS/05/56 project entitled 'Supporting mutation breeding approaches to develop new crop varieties adaptable to climate change' has been sanctioned for the 2012 and 2015.

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