Agronomic performance of salinity and frost tolerant winter wheat genotypes in Central Asia

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Figure 1. Evaluation for frost kill in Urgench, 2014

Figure 2. Evaluation for frost kill in Chimbay, 2014

Figure 3. Farmers' field organized to jointly evaluate performance of wheat genotypes, Chimbay, 2014

Figure 4. "Aral" – Salinity and frost tolerant candidate cultivar in Uzbekistan, 2015 (OK82282//BOW/NKT/3/F4105/4/KS97P0630-4-5: TCI001557: -030YE-030YE-1E-0E -3E-0E)

Figure 4. "Amudarya" - Salinity and frost tolerant candidate cultivar in Uzbekistan, 2015 (VORONA/HD2402/6/VEE/TSI//GRK/3/NS55.03/5/C126.15/COFN/3/N10B/P14//P101/4/KRC67 (TCI 001482-030YE-030YE-2E -0E-3AP-0AP)

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Introduction

Salinity and frost are two important abiotic constraints to successful winter wheat production in many parts of Central Asia. Identification of high yielding frost tolerant winter wheat varieties suitable for medium level of soil salinity (6-10 dS/m) is an important wheat breeding objective for the Aral Sea Region. International collaboration in the region supported through BMZ/GIZ and CGIAR Research Programs on wheat (CRP WHEAT) and dryland systems (CRP DS) identified a number of winter wheat varieties tolerant to frost and medium level salinity.

Objectives

- Evaluate agronomic performance of frost and salinity tolerant winter wheat genotypes
- Identify superior genotypes to be used as new varieties and/or as parents in crossing programs

Materials and Methods

- Fourteen experimental lines and one widely grown commercial cultivar in the region ('Krasnodar-99) were included in the study.
- The study was conducted in replicated (2 to 3 replications) field experiments in 2013-2014 and 2014-2015 wheat growing seasons using 50 m^2 individual plots.
- Crop stand was evaluated before and after winter to assess frost kill (Figs. 1 and 2).
- A group of farmers also evaluated standing crop in both years (Fig. 3).
- Agronomic data on heading, plant height, and grain yield were recorded.
- Quality data on 1000-kernel weight (TKW), test weight, grain hardness, and protein and gluten content were recorded.
- Superior genotypes were identified based on field evaluation for agronomic score, grain yield, maturity, plant height and selected quality traits.

Results and Discussion

- Arrays of genotypic variation occurred among the 14 winter wheat genotypes for grain yield, TKW, days to heading, plant height and selected quality related traits (Table 1).
- Several experimental lines were superior to the local check (Krasnodar-99) for grain yield. Agronomic parameters and selected quality traits of high yielding lines were equal to or better than the local check.
- Based on agronomic evaluation of standing crop in the field, grain yield, maturity, and quality related traits UZ10MLY-20, KR11-9824 and Kiriya were identified superior among the frost tolerant lines.
- UZ10MLY-20 (Fig. 4), and KR11-9824 (Fig. 5) have been identified as candidate cultivars for submission to the State Variety Testing Commission in Uzbekistan.
- These results have open possibilities for developing superior frost and salinity tolerant winter wheat genotypes for other regions with the problem of either frost or salinity or both.

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Entry name	Pedigree	Origin	Grain yield (t/ha)			1000-kernel weight (g)	Test weight (g/l)	Grain hardness	Flour protein (%)	Flour gluten (%)	Days to heading	Plant height (cm)	Agronomic score 1= poor 5=best
			Chimbay 2014	Chimbay 2015	Urgench 2015								
Krasnodar-99 (check)	KN2665G10233/KN4695H449//KN2621H24-82	Russia	2,58	4,18	4,41	48,0	788	85	12,1	28,4	219	89	4
KR11-9809	BTZ7	Bulgaria	2,27	3,66	4,03	51,5	813	71	13,5	36,0	221	91	4
KR11-9811	HK1/6/NVSR3/5/BEZ/TVR/5/CFN/BEZ//SU92/CI13645/3NAI 60 (-0AP-DH2)	IWWIP†	3,52	4,16	4,37	51,5	814	80	13,5	32,4	217	90	4
UZ10MLY-14	4WON-IR-257/5/YMH/HYS//HYS/TUR3055/3/DGA/4/VPM/MOS (TCI-02-80-0AP-0AP-5AP-0AP-3AP-0AP)	IWWIP	4,20	5,58	5,66	50,2	806	86	13,0	26,4	220	90	4
KR11-9816	MV-BODRI	Hungary	2,91	4,17	5,07	49,5	811	88	11,6	30,8	218	93	3
KR11-9824	OK82282//BOW/NKT/3/F4105/4/KS97P0630-4-5 (-030YE-030YE-1E-0E -3E-0E)	IWWIP	2,99	6,30	5,68	50,5	792	81	11,7	28,6	218	90	5
KR11-9828	Vatra	Maldova	1,06	3,14	4,81	50,8	813	80	12,3	33,6	224	95	3
UZ10MLY-20	VORONA/HD2402/6/VEE/TSI//GRK/3/NS55.03/5/C126.15/COFN/3/N10B/P14//P101/4/KRC67 (TCI 001482-030YE-030YE-2E -0E-3AP-0AP)	IWWIP	5,22	5,89	5,21	53,8	798	74	11,9	36,0	218	94	5
KR11-9831	TAM103/LCO//TJB368.251/BUC/3/BWD/4/494J6.11 (-030YE-030YE-2E-0E -1E-0E)	IWWIP	3,08	4,25	5,55	53,5	803	76	11,3	29,2	221	87	4
KR11-9835	JAGGER/TX93V5722//TX95D8905	USA	2,46	3,88	4,90	45,0	813	80	12,3	33,5	219	93	4
KR11-9840	GUAM92//PSN/BOW/3/Thk//4141W113/Karl (-0YA-030YE-1E -0E-2AP-0AP)	IWWIP	2,83	4,31	4,77	48,5	808	94	11,5	29,2	218	91	4
UZ-11CWA-24	ZANDER-10//BOW/NKT (TCI981079-0E-0E-4E-0E-1E-0E)		2,36	4,45	4,50	49,0	-¶	-	-	-	219	90	3
Kuyalnik	ODESSKAYA-KRASNOKOLOSAYA/OLVIYA//ALBATROS-ODESSKII	Ukraine	3,74	4,17	4,84	51,0	-	-	-	-	218	90	4
Victoriya	LINE-57-80/ERYTHROSPERMUM-4240-82//ALBATROS-ODESSKII	Ukraine	2,86	5,12	4,98	51,0	780	82,00	12,60	27,60	219	89	4
Kirya	OBRII/YUZHNAYA-ZARYA//LAN/3/YUBILEINAYA-75	Ukraine	5,30	5,35	5,91	51,5	805	80,00	12,80	26,80	217	91	40
	$LSD_{0.05}$		1,53	0,86	0,97	5,6				3,4	3	4	
	CV (%)		22,4	9,2	9,1	5,1							

†IWWIP: International Winter Wheat Program
¶Data not available

Table 1. Performance data of 14 wheat experimental lines and one check in two sites in Uzbekistan, 2014 and 2015