

Genotypic variation for frost tolerance in winter wheat



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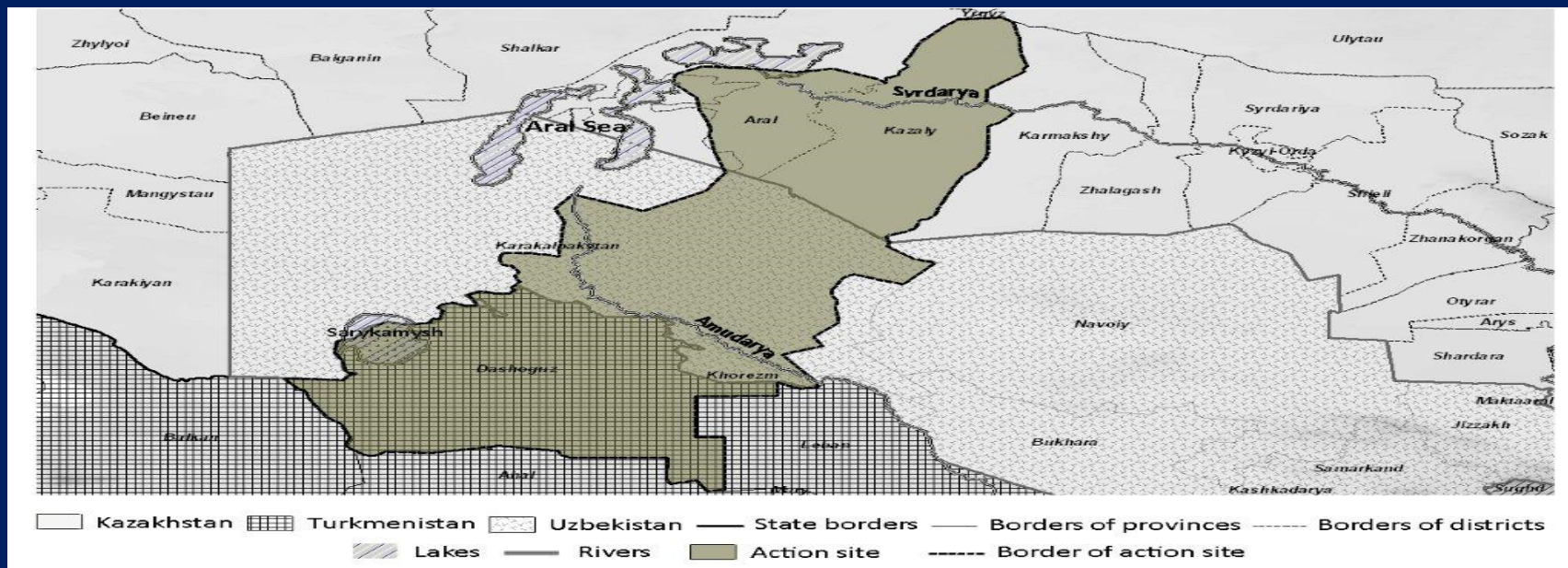
¹ICARDA, ²Uzbek Res. Inst. of Plant Industry, ³Karakalpakstan Res. Inst. of Crop Husbandry

2nd International Plant Breeding Congress, 1-5 November, Antalya, Turkey

Scope of presentation

- Frost as a constraint to winter wheat production
- Germplasm evaluation
- Frost management
- Successes – tolerant lines and varieties

Research Site



CGIAR Research Program on Dryland Systems (CRP1.1) Action Site: Aral Sea Region

Temperatures: -20 to -30°C, without snow cover

Frost as a problem to winter wheat



Turkmenistan, 2013
-29°C, end February
Loss up to 100%



Tajikistan, 2014
-25°C, early March
Loss up to 100%



Uzbekistan, 2013
-15°C, end March
Loss up to 70%

Frost kill – 16 February 2015

Wheat crop without snow cover



Frost Damage: 31 March – 2 April 2015

Fergana, Uzbekistan



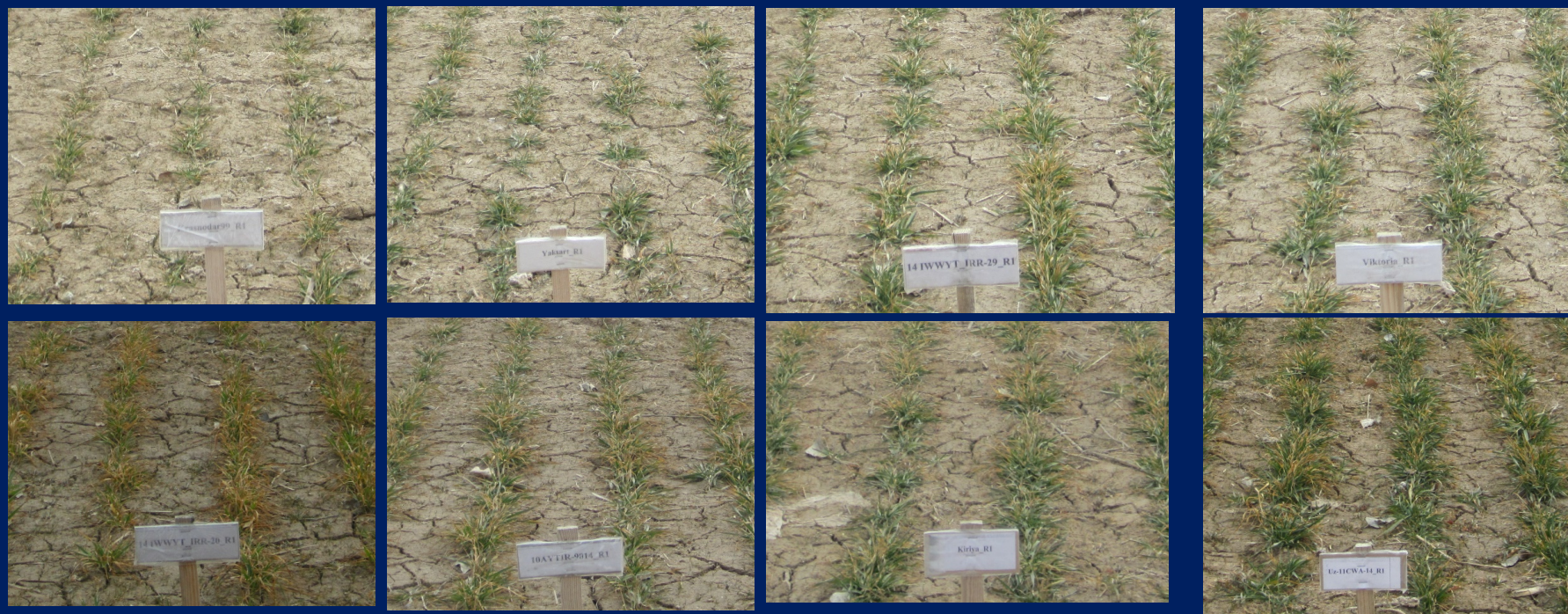
Wheat growing options for Aral Sea frost-prone zone

- Frost tolerant winter wheat varieties
- Heat tolerant spring wheat varieties (>40C, 80 days maturity)
- Alternative crops

Methodology

- Annually evaluate 150 – 200 advanced breeding lines (since 2013)
 - Frost tolerance
 - Agronomic performance
 - Yield and quality
- Frost management through agronomic practices
 - Deeper than normal seeding depth for autumn and winter frost
 - Additional fertilization and irrigation for early spring frost

Genotypic variation for frost tolerance



Genotypic variation for frost tolerance

7 March 2014, Urgench, Uzbekistan



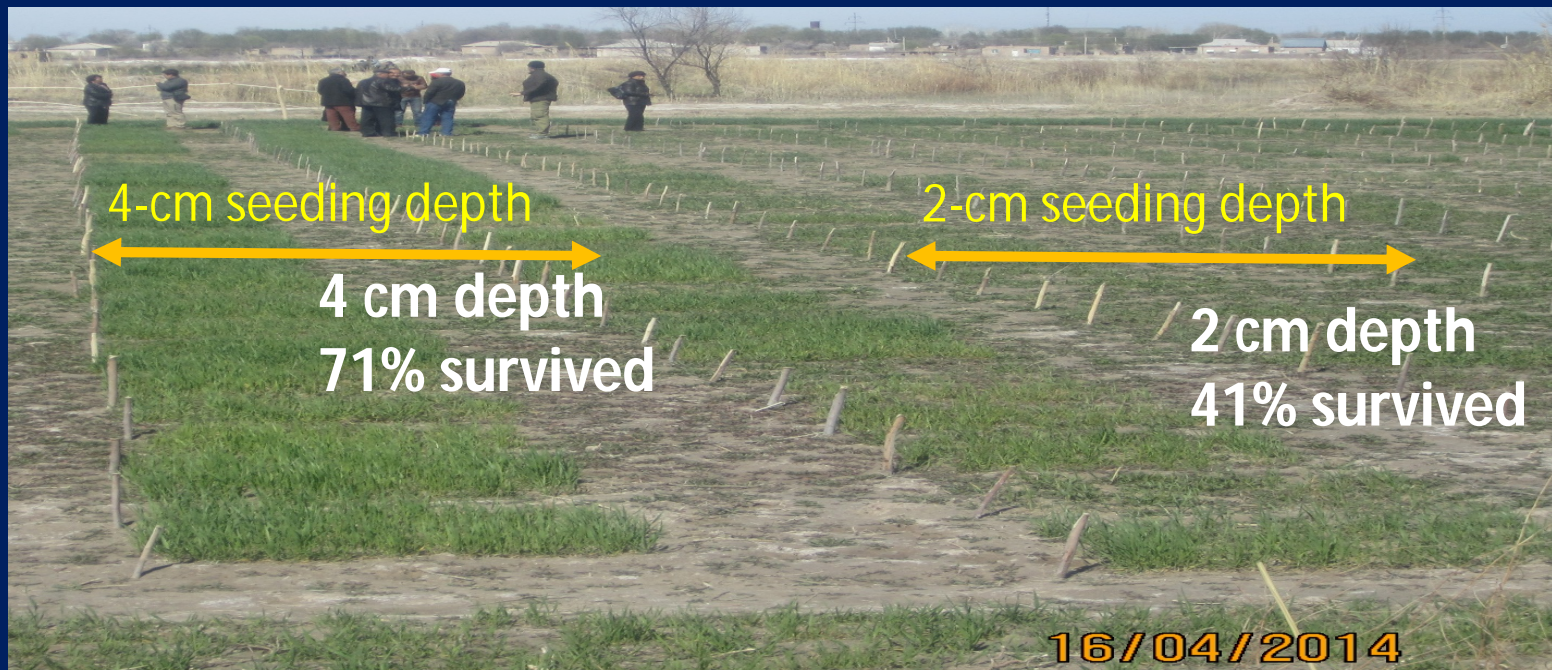
Genotypic variation for frost tolerance 2013, Urgench, Uzbekistan

17 of 150 lines
were tolerant



Variation for frost tolerance at two planting depths

150
genotypes
evaluated



Frost kill	Seedind depth	
	4-cm	2-cm
Number of lines with $\leq 20\%$ frost kill	97	38
Number of lines with $\leq 10\%$ frost kill	75	25

Variation for frost tolerance

21FAWWON-IRR

Aral Sea Region
Uzbekistan
2014

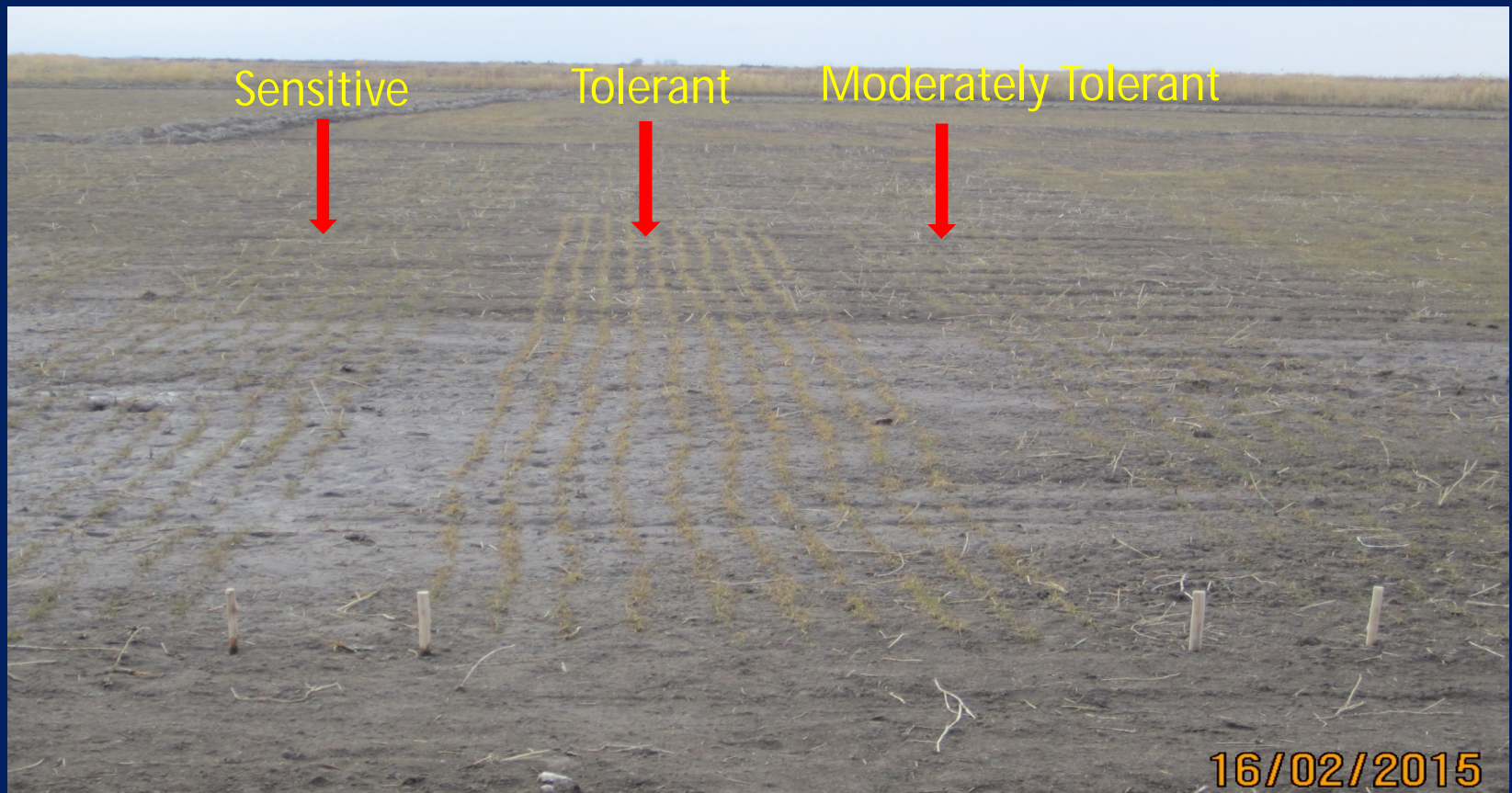
19 of 157 selected

Entry number	Variety name	Frost kill (%)	Grain yield (g/m ²)
1	Bezostaya 1 (check)	0	393
2	Seri (check)	100	
3	Sultan 95 (check)	0	197
4	Katia 1 (check)	80	
5	Konya (check)	0	435
6	Krasnodar 99	0	345
98	OK07214	0	645
96	F07098G1	0	521
99	OK07218	0	477
97	F07270G2	0	450
23	Jcam/Emu//Dove/3/Jgr/ 4/Thk/5/Boema	0	448
18	Polovchanka/Pehlivan	0	447
109	Grom	0	444
100	OK09634	0	428



21FAWWON-IRR

Genotypic variation for frost tolerance 16 February 2015, Nukus, Uzbekistan



31 of 102
selected

Frost tolerant new winter wheat varieties, 2014 - 2015

Davlatle
Turkmenistan



135U 6.1/5/CNDO/R143//
ENTE/MEXI75/3/AE.SQ/4/2*OCI,
CMSW01WM00832S: -030YE-30E-1E-
0E-4E-0E

Amudarya
Uzbekistan



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



Aral
Uzbekistan



OK82282//BOW/NKT/3/F4105/4/KS97P0630-4-5
TCI 001557: -030YE-030YE-1E-0E -3E-0E

Tolerance to multiple abiotic stresses

- Frost tolerance
- Tolerance to medium level salinity (6 to 10 dS/m)
- Heat tolerance (temperature during grain filling $>40^{\circ}\text{C}$)
- (Drought tolerance)

Salinity tolerant winter wheat (Davlatle)

Also tolerant to drought, heat and frost

Dashoguz, Turkmenistan

135U 6.1/5/CNDO/R143//ENTE/MEXI75/3/AE.SQ/4/2*OCI,
CMSW01WM00832S: -030YE-30E-1E-0E-4E-0E



Performance of frost tolerant new varieties

- Grain yield: 3 – 7 t/ha (30 to 100% higher than checks)
- Maturity: earlier than or similar to checks
- Quality related traits: Comparable to or better than checks

Performance of frost tolerant new varieties

Variety name	Grain yield (t/ha)	1000-kernel weight (g)	Plant height (cm)	Days to heading
Davlatle	3.00	45	66	206
Krasnodar-99 (Improved Check)	2.00	47	56	212
Sahra'y (Old Local Check)	1.15	50	53	209
LSD _{0.05}	0.59	4	9	2
CV (%)	12.1	4.2	7	0.5

Two new winter wheat varieties in Uzbekistan- 2015



Aral

OK82282//BOW/NKT/3/F4105/4/KS97P0630-4-5
TCI 001557: -030YE-030YE-1E-0E -3E-0E



Amudarya

VORONA/HD2402/6/VEE/TSI//GRK/3/NS55.03/5/C126.15/COF
N/3/N10B/P14//P101/4/KRC67; TCI 001482: -030YE-030YE-2E -
0E-3AP-0AP

Entry name	Grain yield (t/ha)			1000- kernel weight (g)	Test weight (g/l)	Grain hardness	Flour protein (%)	Flour gluten (%)	Days to headin g	Plant height (cm)	Agrono mic score
	Chimba y 2014	Chimba y 2015	Urgen ch 2015								
Krasnodar-99 (check)	2.58	4.18	4.41	48.0	788	85	12.1	28.4	219	89	4
Amudarya	4.20	5.58	5.66	50.2	806	86	13.0	26.4	220	90	4
Aral	2.99	6.30	5.68	50.5	792	81	11.7	28.6	218	90	5
LSD _{0.05}	1.53	0.86	0.97	5.6				3.4	3	4	

Summary

- Arrays of genotypic variation occurred among the winter wheat genotypes adapted to Central Asia and the advanced breeding lines introduced from IWWIP in Central Asia
- Many frost tolerant genotypes also possessed superior agronomic and grain characteristics, which were advanced to further evaluations
- Seeding depth significantly influenced frost survival
- Three frost tolerant varieties (2 in Uzbekistan and 1 in Turkmenistan) have been identified

Acknowledgements

- National wheat improvement programs in Uzbekistan, Turkmenistan and Tajikistan
- ICARDA
- CRP Dryland Systems
- CRP WHEAT
- International Winter Wheat Improvement Program (IWWIP)

Thank you for your attention!