Eco-friendly new winter wheat varieties developed through international collaboration reduce application of fungicides and save input cost

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Программа по Устойчивому Развитию Сельского Хозяйства в Центральной Азии и Закавказье

CAC
ЦА3

Program for Sustainable Agriculture in Central Asia and the Caucasus

The Eco-Regional Program for Sustainable Agricultural Development in Central Asia and the Caucasus (CAC)

… aims to achieve

- overall food security
- enhanced productivity
- environmental sustainability
- economic growth
- poverty alleviation

Kazakhstan

Kyrgyzstan

Tajikistan

Turkmenistan

Uzbekistan

Armenia

Azerbaijan

Georgia

How it started….

During the former Soviet Union:

- Exchange of germplasm; germplasm collections in Turkmenistan and Uzbekistan, exchange of visits
- First scientist from ICARDA visited Kazakhstan in 1987
- A scientist from Uzbekistan at GRU of ICARDA, 1989-90

But all this, only through Moscow

After Independence:

- Lucerne declaration, 1995
- CGIAR Task Force, late in 1995
- A series of consultation meetings in 1995, 1996, 1997
- In 1998, CGIAR CAC Program established with ICARDA as the Convening Center
- CGIAR/WB allocates 2 mln USD of seed funding for the Program

Program Elements

Productivity of Agricultural Systems

Germplasm Enhancement

Strengthening National Seed Supply Systems

Cropping Systems Management and Agricultural Diversification

Livestock Production Systems and Integrated Feed/ Livestock Management

Natural Resource Conservation and Management

Irrigation, Drainage, and Water Basin Analysis

On-Farm Soil and Water Management

Rangeland Rehabilitation and Management

Conservation and Evaluation of Genetic Resources

Plant Genetic Resources

Animal Genetic Resources

Socioeconomic and Public Policy Research

STRENGTHENING NATIONAL PROGRAMS

Research Prioritization: a bottom-up approach

Research Needs Assessment Meetings have been held
1995, 2001, 2002, 2006, 2007,2010
with all partners in a bottom-up approach

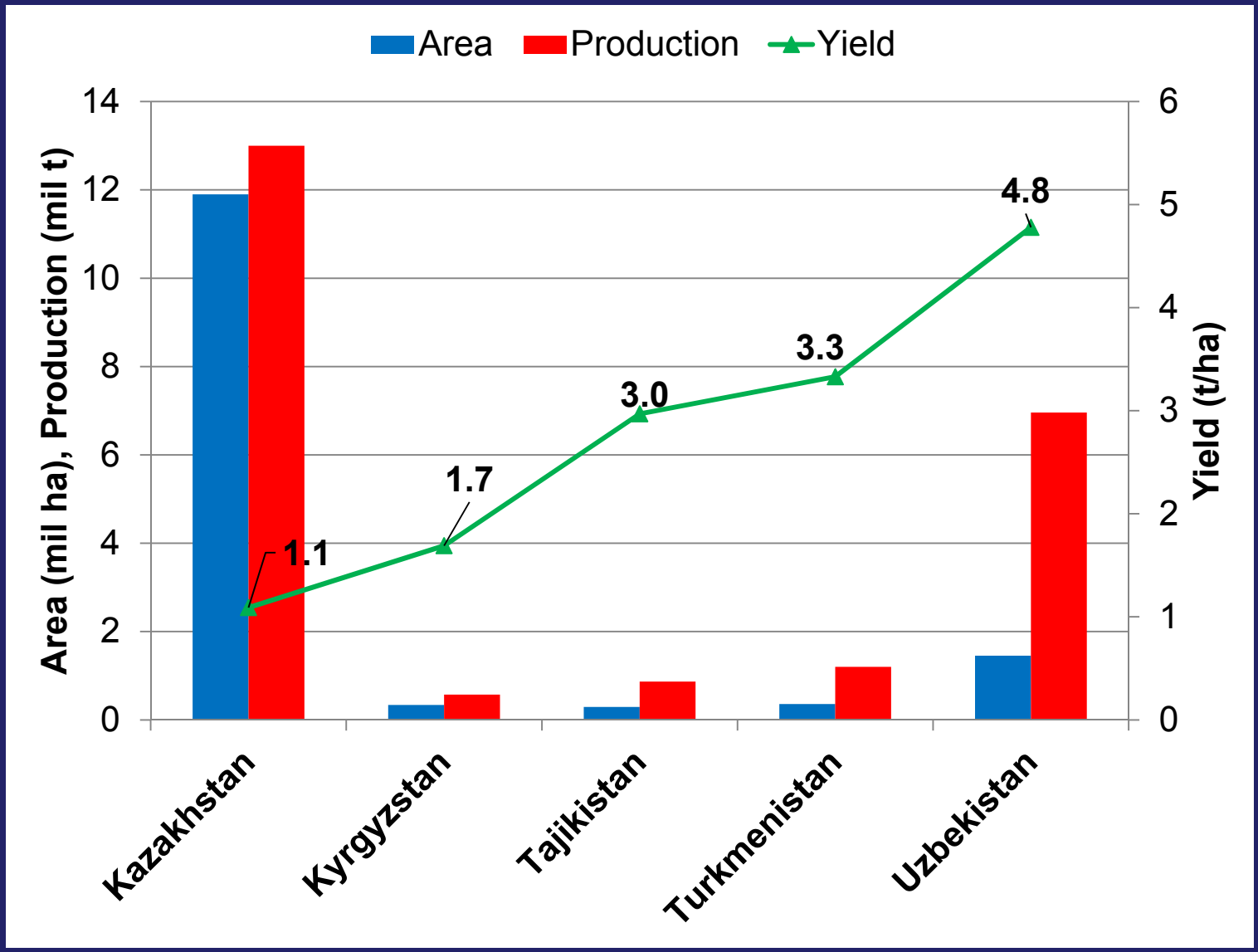
Scope of presentation

- Constraints to wheat production in the context of climate change
- International collaboration
- Major constraints: yellow rust disease and soil salinity
- Not covered: heat, drought, insect pests and other diseases, inefficient seed systems, socio-economic and policy constraints
- Achievements

Why wheat is so important in the context of climate change and food security in Central Asia?

- Wheat constitutes 85% of all cereals
- Major staple
- Highest level of foreign currency invested on wheat export by all countries except Kazkahstan
- Year to year variation may result in 20 to 50% fluctuations in wheat production
- Disease epidemics can cause millions of dollar investment in chemical control

Wheat statistics in Central Asia, 2014



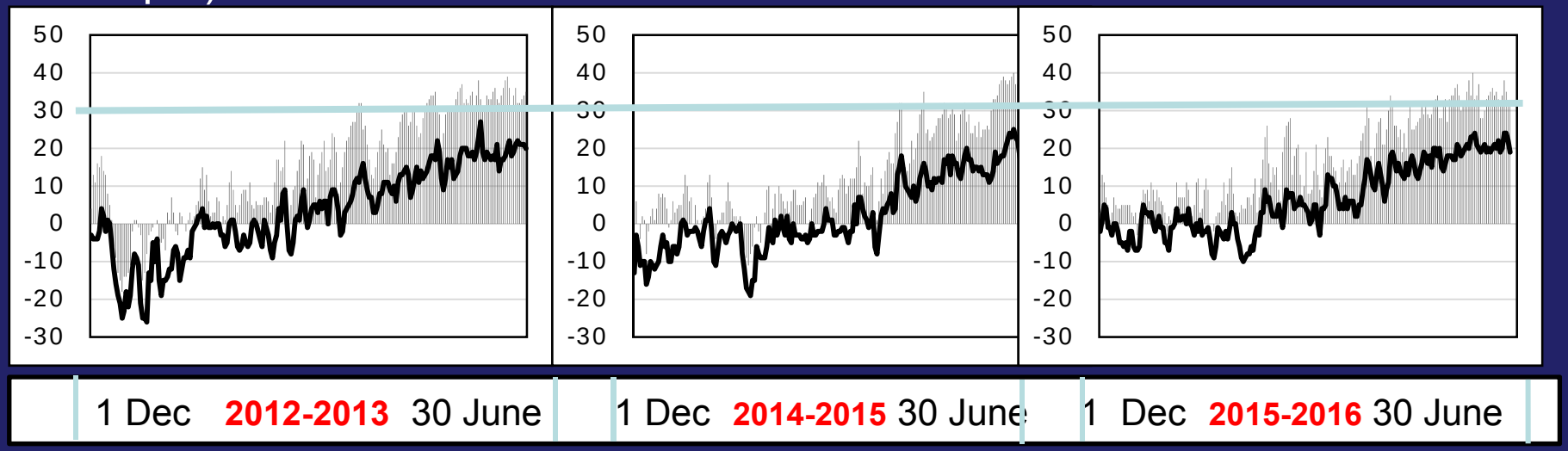
Source: FAO, 2016

Expected events under climate change

- More extreme events (wet/dry/heat)
- Change in rainfall / less water for irrigation
- Temperature rise
- More aggression / new diseases and pests
- Negative impact on soil health
- Food security

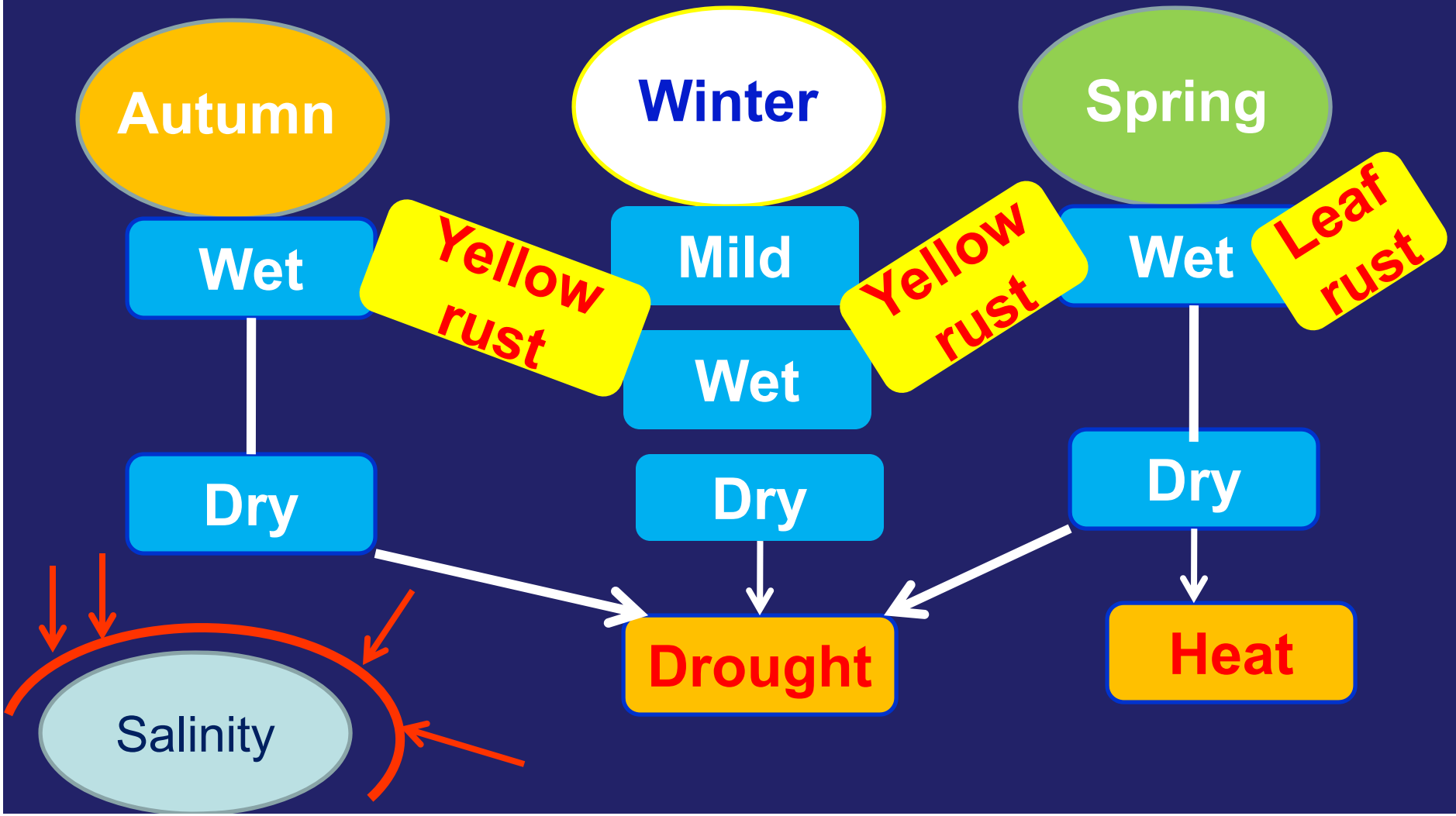
Temperatures during winter crop months – Aral Sea (Nukus)

- 2015-2016 was warmest winter in the memory, some fruit trees flowered in late January (normal flowering time March - April)



- In a year like 2012-2013 winter wheat suffered both from winter frost and spring heat

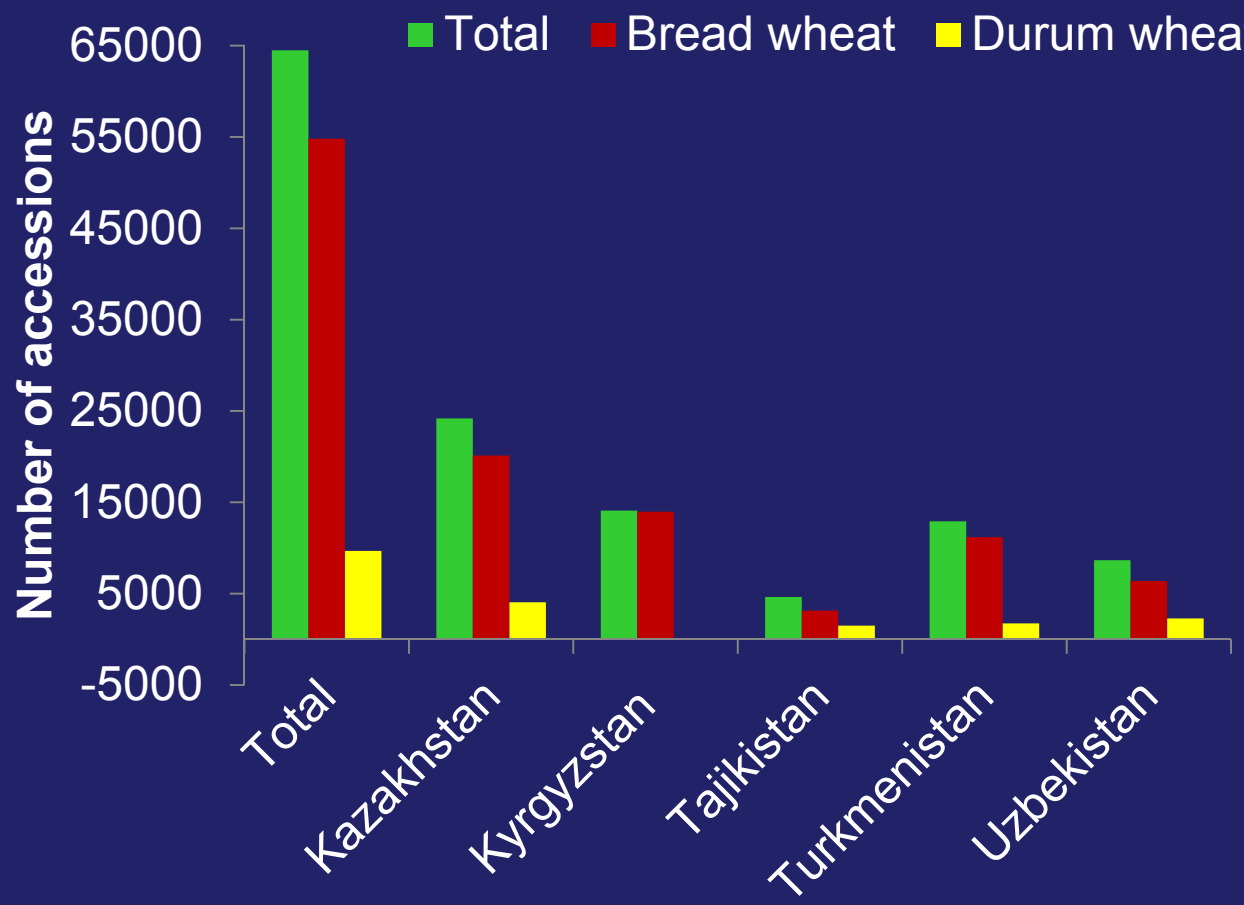
Constraints to wheat production under climate change



What is International Collaboration doing in terms of germplasm?

- Introduction of improved wheat germplasm
- Identification of stress tolerant varieties
- Capacity development

Wheat germplasm received in Central Asia: 1995 and 2011



Importance of wheat yellow rust in Central Asia

- Six yellow rust epidemics since 2009

  2009, 2010, 2013, 2014, 2015, 2016

Kroshka
2009, Uzbekistan

Nota
2010, Tajikistan

Krasnodar-99
2013, Tajikistan

Yellow Rust Epidemics – 2013, Tajikistan

Seed Multiplication Field

Natural epidemics of yellow rust in winter wheat nurseries in Tajikistan, 2013

Natural and artificial epidemics of yellow rust in winter wheat nurseries in Uzbekistan, 2013

Breakdown of resistance in major varieties in Uzbekistan

Name of variety	Year of release	Level of yellow rust severity when released	Year when became susceptible to yellow rust	Level of yellow rust severity at present
Kroshka	2000	5 MR	2009	100 S
Polovchanka	1999	10 MR	2009	100 S
Pamyat	2006	R	2010	100 S
Moskvich	2007	R	2009	100 S
Krasnodar99	2006	R	2009/2013	60 S / 100 S
Tanya	2006	R	2009/2013	60 S / 80 S
Chillaki	2002	20 MR	2009	100 S
Bobur	2006	20 MR	2009	80 S

Yellow rust on leading commercial winter wheat cultivars

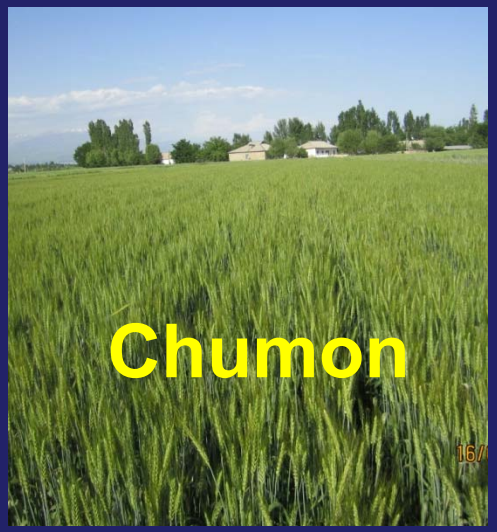
Country	Variety	Stripe rust severity (%)
Kazakhstan	Almali	40 MS
Kyrgyzstan	Azribos	40 MR
Tajikistan	Navruz	90 S
Turkmenistan	Bitarap	60 S
Uzbekistan	Krosnodar 99	100 S
Armenia	Bezostaya 1	50 S
Azerbaijan	Azamatli 95	70 S
Georgia	Bezostaya 1	70 S

Wheat grain yield reductions due to yellow rust

- 2010
  - 28 ± 1.6% - Uzbekistan
- 2011
  - 30 ± 0.8% - Tajikistan
  - 29 ± 1.3% - Uzbekistan

Source: Sharma et al. (2016), J. Phytopathology 164:671-677

New, improved wheat varieties, resistant to yellow rust



Wheat varieties that survived six yellow rust epidemics (2009, 2010, 2013, 2014, 2016)

Buniyodkor

DORADE-5//KS82117/MLT
TCI-02-88: -0AP-0AP-19AP-0AP-3AP-0AP

Gozgon

AGRI/BJY//VEE/3/AKULA/4/F10S-1
(TCI972515: -0SE-0YC-0YE-26YE-0YE-1YE-0YE)

Elomon

- Suitable for fewer irrigation

Agronomic performance of yellow rust resistant lines

- Grain yield: 6 to 8 t/ha (‘>’ than or ‘=‘ to checks)
- Comparable to or better than checks for
  - Grain appearance
  - Maturity
  - 1000-kernel weight
  - Plant height
  - Protein and gluten content
  - Agronomic score

Selected lines advanced to 2013-14

Pedigree / Name	Source	YR Sev (%)	Yield (t/ha)	Yield (t/ha)
Kambara1/Kalyoz-17	16IWWYTIR-6	30	8.349	4.475
TAM200/Kauz//Becuna-6	16IWWYTIR-7	5	7.170	3.436
Seri.1B*2/3/Kauz*2/Bow//Kauz/4/Bagci2002	16IWWYTIR-9	0	6.038	4.508
Agri/Nac//Kauz/4/55.1744/Mex67.1//No57/3/Attila	16IWWYTIR-11	5	8.208	4.519
JI5418/MARAS//SHARK/F4105W2.1	16IWWYTIR-14	0	8.302	5.272
Shark-1/3/Agri/Bjy//Vee/4/Shark/F4105W2.1	16IWWYTIR-15	0	8.396	5.142
Shark-1/3/Agri/Bjy//Vee/4/Shark/F4105W2.1	16IWWYTIR-16	5	6.981	4.431
4WON-IR-257/5/Ymh/Hys//Hys/Tur3055/3/Dga/4/Vpm/Mos	16IWWYTIR-25	0	7.925	5.989
Zarrin/Shiroodi/6/Zarrin/5/Omid/4/BB/Kal//Ald/3/Y50E/Kal*3//Emu	16IWWYTIR-32	25	8.302	5.892
Local Check (Jaihun)		**70**	**8.491**	**2.736**
$LSD_{0.05}$		22	1.104	1.538
CV (%)		23	7.4	16.9

Farmers' Training on Wheat Seed Production

Fergana, Uzbekistan
5 August 2014

Nukus, Uzbekistan
7 August 2014

Khorezm, Uzbekistan
9 August 2014

Khujand, Tajikistan
16 October 2014

Wheat Farmers' Field Day

Capacity development of young researchers

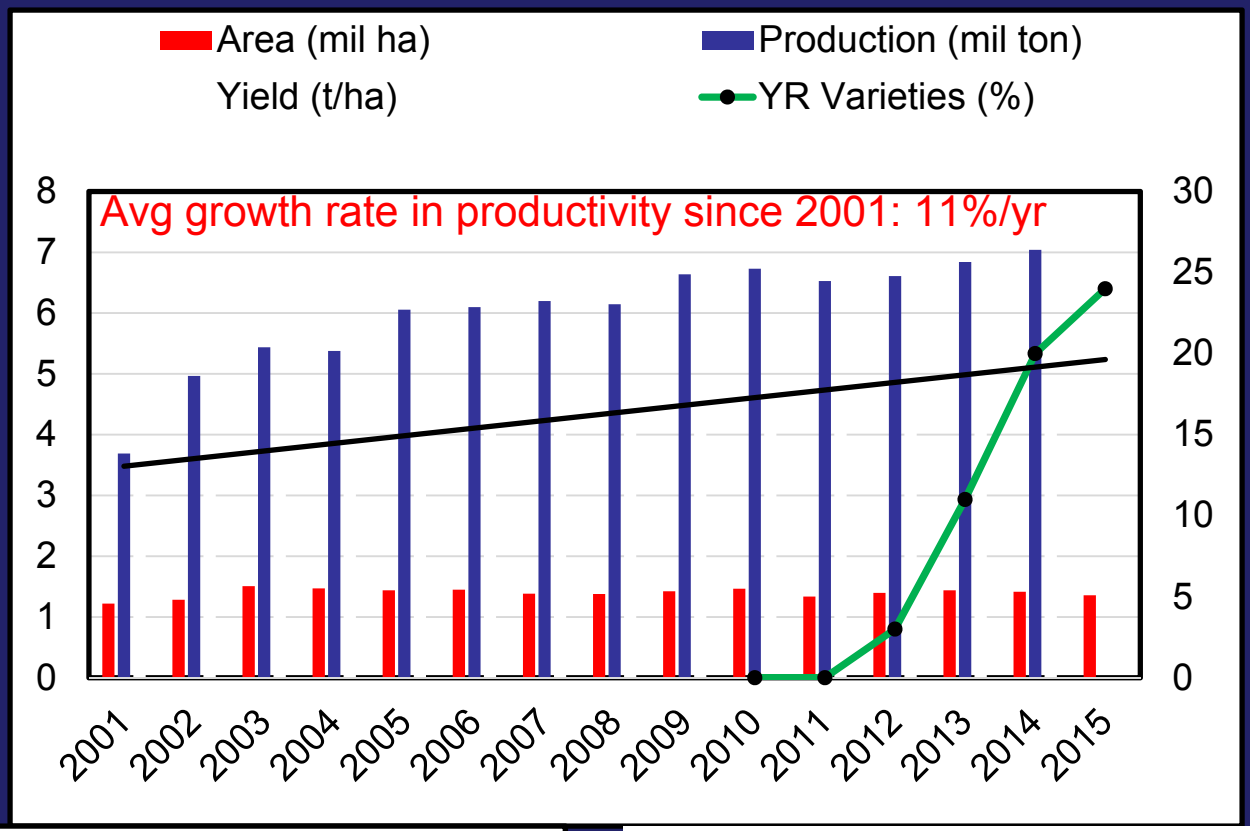







International Winter Wheat Traveling Seminar, Kashkadarya 20-15 May 2013, Uzbekistan

Economic implications of wheat yellow rust and benefit from growing resistant varieties, an example



Cost of fungicide spray:
1-3 sprays (70 to 210 USD/ha)
Saving from 20% area
200,000 ha = USD 14 – 42 million
Environment friendly

2016 case: epidemic lasted for 4 months
1 to 3 fungicide sprays

Approx. 500,000 ha sprayed
Fungicide cost, 2 sprays: $140/ha
USD 70 million

Summary

- Yellow rust resistant winter wheat varieties
- New varieties have shown resistance under multiple yellow rust epidemics in different years
- Winter wheat farmers have options to plant yellow rust resistant varieties
- Economic benefit from growing resistant varieties

Acknowledgements

- Collaborators in Central Asia and the Caucasus
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Thank you for your attention!
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