

# Wheat rust and Karnal bunt disease of wheat

## “CIMMYT's experience”

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# Global priorities for wheat diseases

Biotic stress	East Asia	South Asia	West Asia	M-East+N-Africa	C-Asia+Caucasus	S-Saharan Africa	L-Americ.+ Mexico	Developed countries
Leaf rust								
Stem rust								
Yellow rust								
FHB								
Septoria								
Spot blotch								
Tan spot								
Nematodes	++	++	+++	++	0	+	+	+
Root diseases	++	++	++	++	0	+	+	+
Smuts/bunt	+	+	+	+	+	+	+	+
Wheat blast	0	++	0	0	0	0	+	0
Powdery mildew	++	+	0	0	0	0	+	++

“Karnal bunt is not specified; too localized, but important for India”

“Priorities change with time”

“Wheat blast has gained sudden importance in South Asia due to 2016 outbreak in Bangladesh”

# Current Concern

Aggressive strains of  
yellow rust with Yr27+  
virulence

Stem rust race:

**RRTTF**

**Yr27 virulence has been  
traced back to East  
Africa**

**International  
collaboration  
important**



YR resistant and susceptible lines (natural condition)

# International collaborative effort example



• About rusttracker.org

[Alerts and Cautions!](#)

[Wheat Rust in the News](#)

**!!!CIMMYT Mexico, Russian Federation, Global Rust Reference Center, Aarhus University, Turkey, University of Cambridge UK, Ethiopia etc**

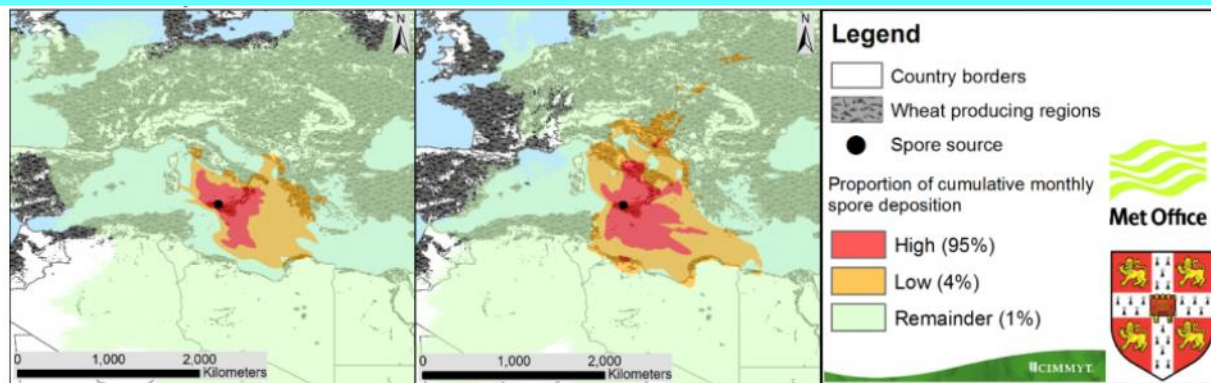
• Stem Rust Tools – Maps & Charts  
• Yellow Rust Tools – Maps & Charts  
• Survey Forms & Protocols  
• Documents

**Contact**

• Contact Details

**Other Sites**

• BGRI (Globalrust.org)  
• CIMMYT  
• CIMMYT Wheat Atlas  
• CIMMYT Wheat Doctor



Wheat rust begins to  
kathmandu Post | 25 February 2017  
• Yellow rust alert in Oxfordshire  
wheat fields Farmers Weekly | 23  
February 2017  
• TTTTF, a kind of stem rust,  
damages tens of thousands of  
hectares of crops in Sicily | newfood  
| 21 February 2017  
• New rust strain threatens wheat  
crops in Europe and North Africa  
|Manitoba Co-Operator |15  
February 2017  
'Huge' diversity in types of yellow

# Aggressive yellow rust races adapted to higher temperature

- Infection initiation at juvenile stages
- Faster multiplication
- Adaptation to warmer temperature and new areas
- Faster evolution
- Reduced effectiveness of resistance genes (including APR)
  - ▶ *Yr36* is effective at 18°C
- Natural condition
  - ▶ Spore germination
    - ◆ 8-13°C
  - ▶ Further development
    - ◆ 12-15°C

- Greenhouse studies
  - ▶ Spore germination
    - ◆ Up to 18°C
  - ▶ Disease development
    - ◆ Up to 25°C

**Need to develop varieties with higher levels of resistance and stability**

# Beware wheat rust, the enemy from the air

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## Beware wheat rust, the enemy from the air

■ Environment, National, Science © September 28, 2017 🧑 Daily World

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TAGS

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By K.S. Jayaraman

Bengaluru, Sep 28 : The wheat crop in Punjab — the breadbasket of India — and also in Pakistan, is vulnerable to air-borne attack by “stem rust” in the event of an outbreak of this disease in a place as far away as East Africa.

This is the finding of the first-ever study aimed at identifying likely scenarios for the global spread of this devastating crop disease caused by a fungus called “Puccinia graminis”.

If this disease erupts in one location, the highly virulent strains of the fungus can spread to distant places through trillions of pathogenic fungal spores dispersed by winds across countries and continents.

The incredibly deadly strain of stem rust Ug99 — so called because it was first detected in Uganda in 1999 — is considered a threat to global food security and has so far not been detected in India.

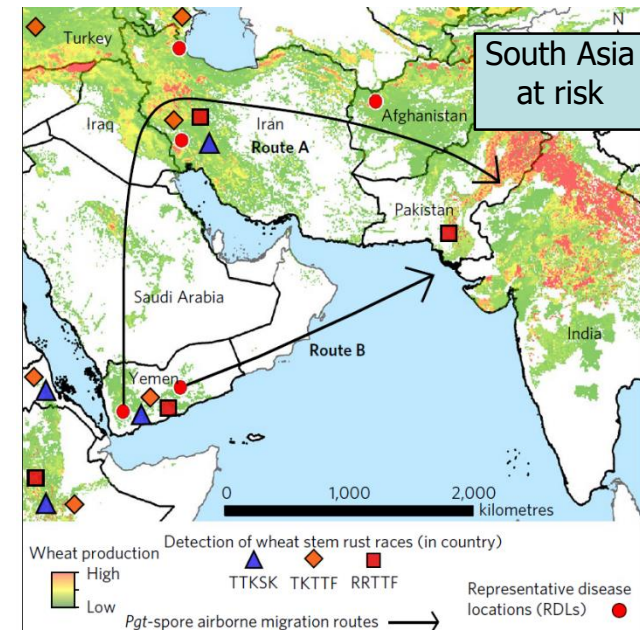
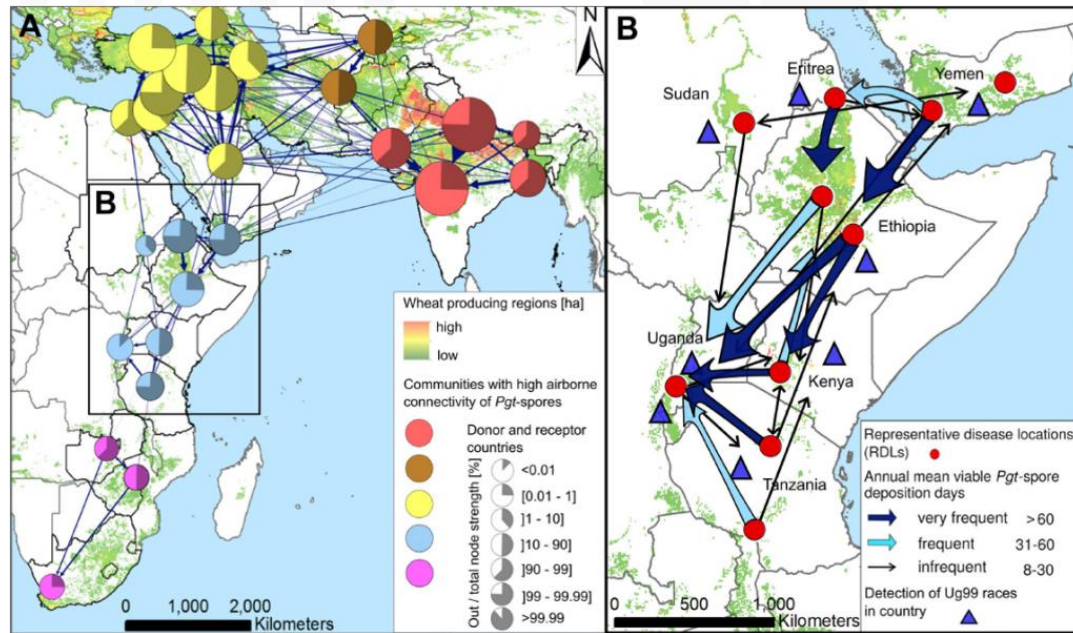
The study — by a team of scientists of the University of Cambridge, the UK Met Office, and the International Maize and Wheat Improvement Centre in Mexico (CIMMYT) — helps to predict which areas are at risk so that precautions can be taken.

The scientists adapted computer modeling systems to forecast when and how Ug99 and other strains are most likely to spread. The scientific team used field disease surveys from CIMMYT and weather data from the UK Met Office as key inputs for the modeling framework.

Their findings, published in the journal Nature Plants, “quantifies for the first time the circumstances — routes, timings and outbreak sizes — under which dangerous strains of stem rust pose a threat from long-distance dispersal out of East Africa to the large wheat-producing areas in India and



# Network map of the atmospheric transmission of stem rust spores



Stem rust migration route modelling

Risk of atmospheric transmission of *Pgt*-spores to South Asia

Source: RustTracker.org; DOI: 10.1038/s41477-017-0017-5

# Our strategy

**We focus on a long-term solution  
“Non race-specific resistance”**

**Use of a single major gene causes boom and bust cycle**

**Faster sharing of CIMMYT's advanced lines through BISA**

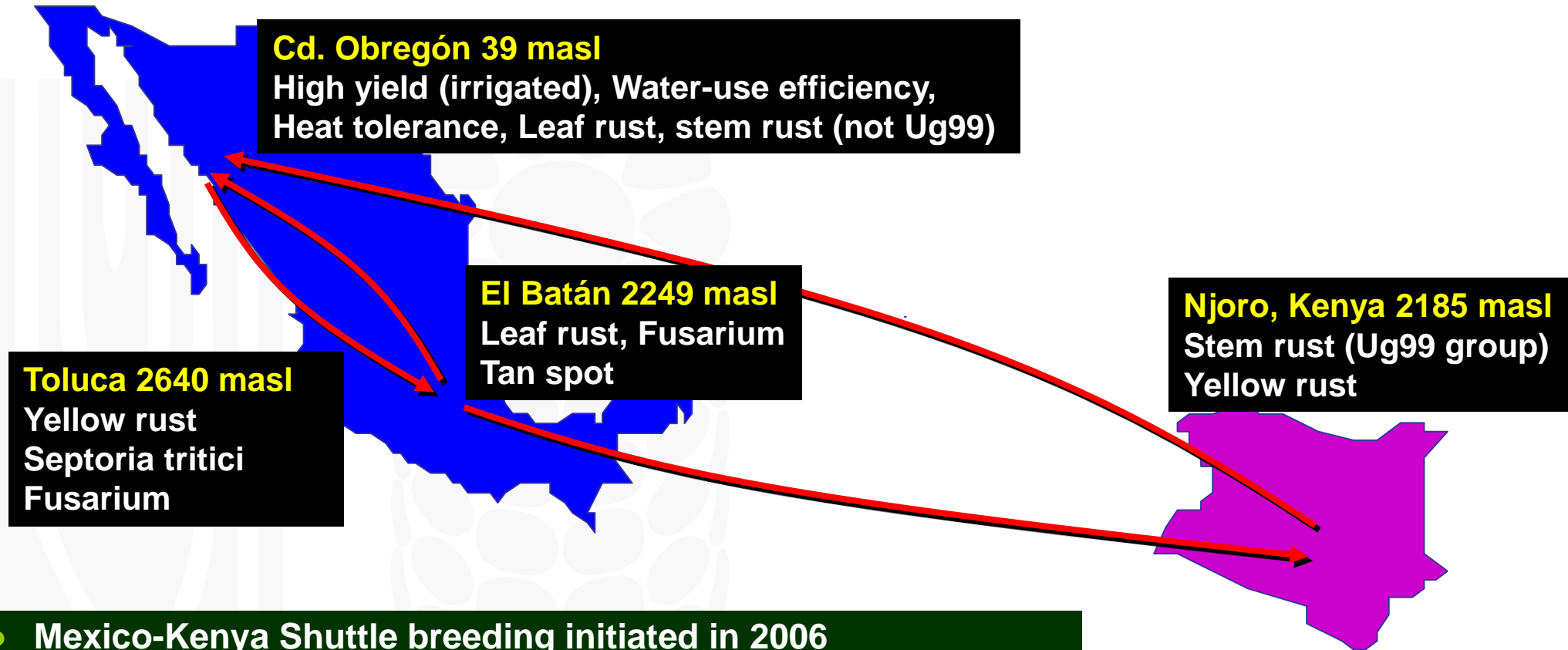


**We shuttle breeding material as well as international experience**



# We shuttle breeding populations

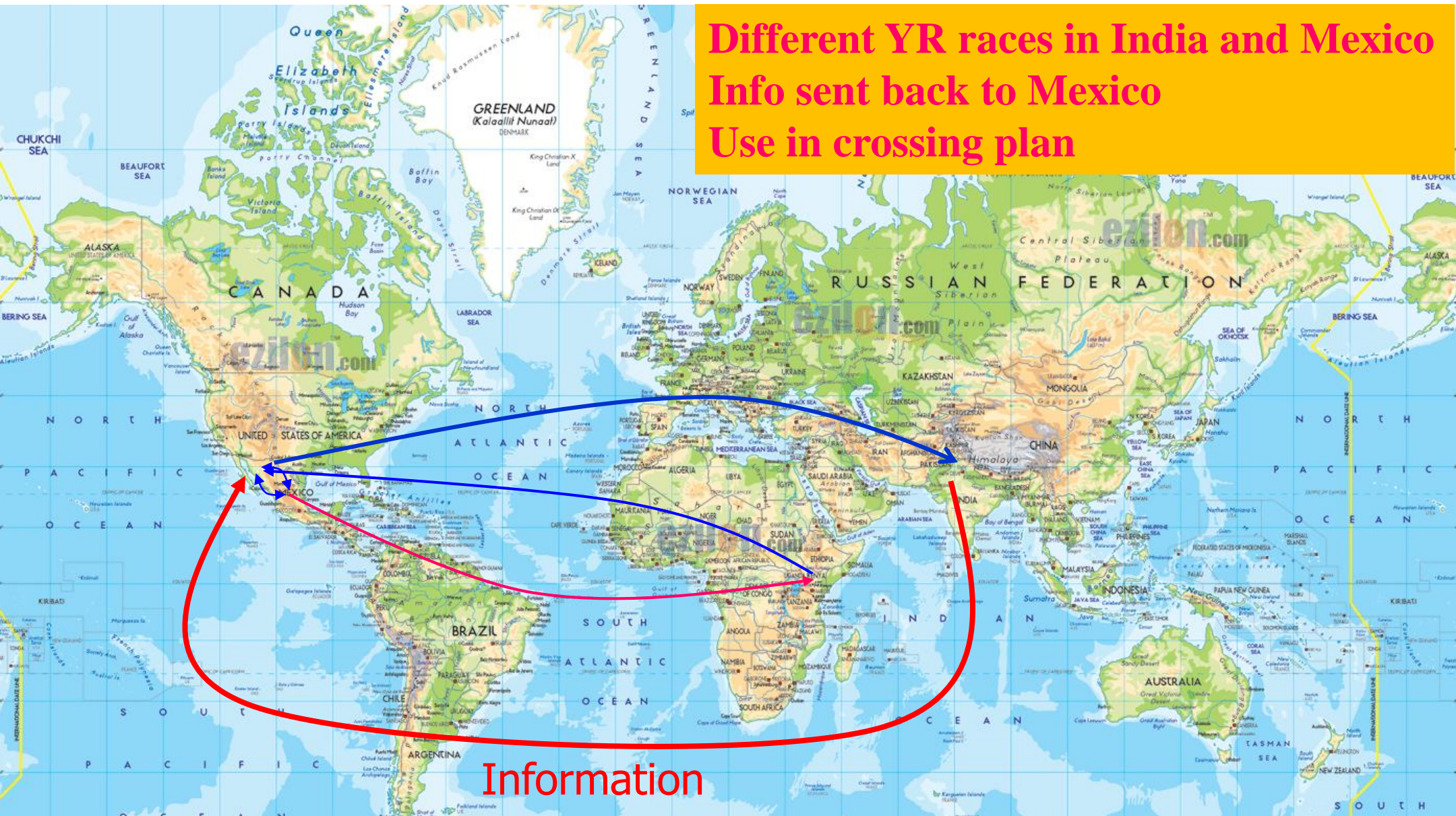
*With in Mexico (Cd. Obregon-Toluca/El Batan) & with Kenya*



- Mexico-Kenya Shuttle breeding initiated in 2006
- About 2000 F3/F4 populations undergo shuttled annually
- High yielding, resistant lines distributed worldwide since 2011

# Information shuttle for yellow rust (Mexico-India)

Different YR races in India and Mexico  
Info sent back to Mexico  
Use in crossing plan



Information

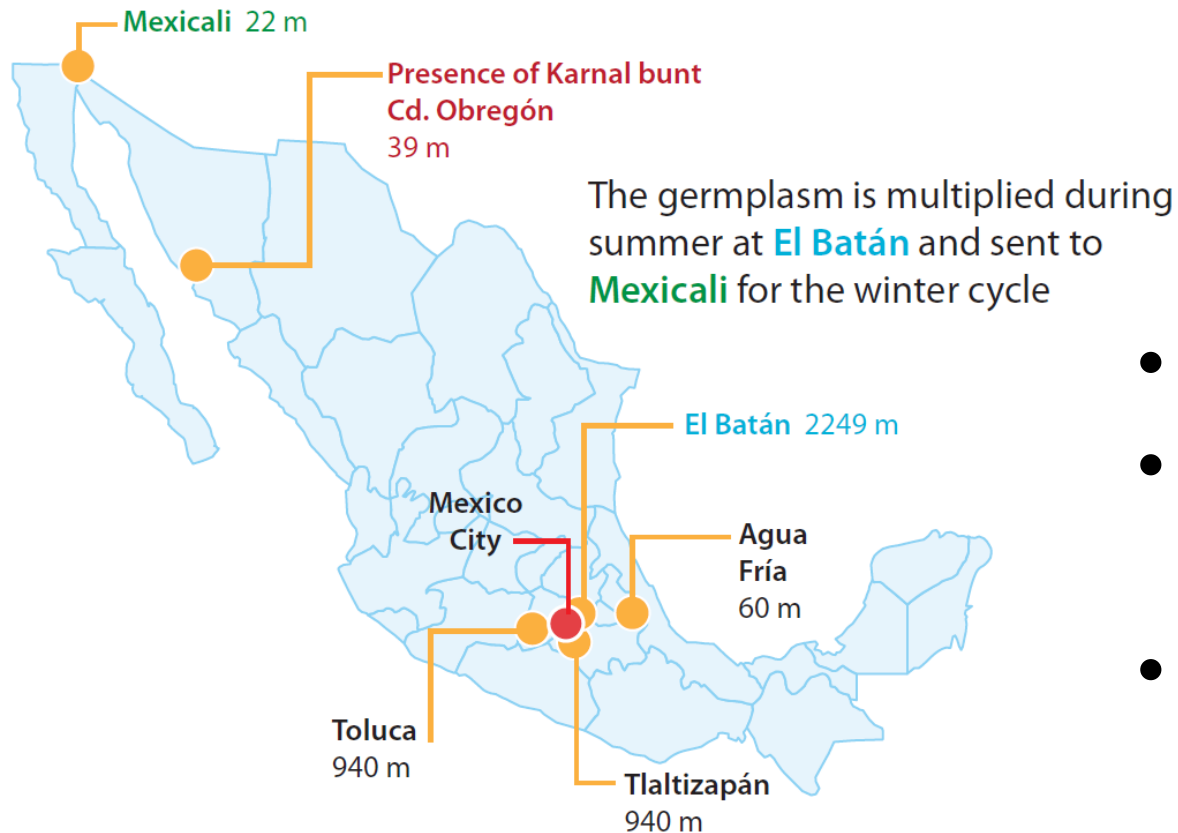
# Progress in breeding potentially durable adult plant resistance (APR) to rusts based on combinations of 4-5 additive slow rusting genes

- **Leaf rust:** strategy has worked very well >70% entries in international nurseries have high to near-immune APR
- **Stem rust:** significant progress made with Ug99 race group >50% entries in international nurseries have adequate to high levels of APR in Kenya
- **Yellow rust:** adjusting the strategy to combat early disease initiation in some areas with the aggressive, temperature tolerant race group

# Karnal Bunt



# Handling of KB in CIMMYT



- Mexicali free from KB
- Seed tested rigorously in SHU in El Batán
- Only after confirmation sent to collaborators

# Managing Karnal Bunt

1. Use of pathogen-free seed
2. Seed treatment (Carboxin @ 2g/kg or Thiram 2.5g/kg seed)
3. Foliar sprays: *Fungicides* (*Propiconazole* or *Tebuconazole* @200ml/per acre in 200 Ltr water)
4. Cultural practices
  - a. Zero tillage
5. Host Resistance: *Best strategy but still to be demonstrated in large scale.*

# Breeding for Resistance to KB

- **Resistance sources in bread wheat are known but important varieties are susceptible**
- **Durums are more resistant**
- **Resistance is complex; requires pyramiding 4-5 additive genes with small to intermediate**
- **Challenge:**
  - ▶ **Screening for resistance is cumbersome**
  - ▶ **2-3 years of screening is necessary to confirm resistance**

**CIMMYT derived Indian wheat variety ‘Super172’ (Munal) has shown near-zero KB infection in 5 years of testing in Mexico. However currently it shows moderate susceptibility to yellow rust in India.**



New tools: Genomic Selection Assisted Breeding

&  
High throughput phenotyping

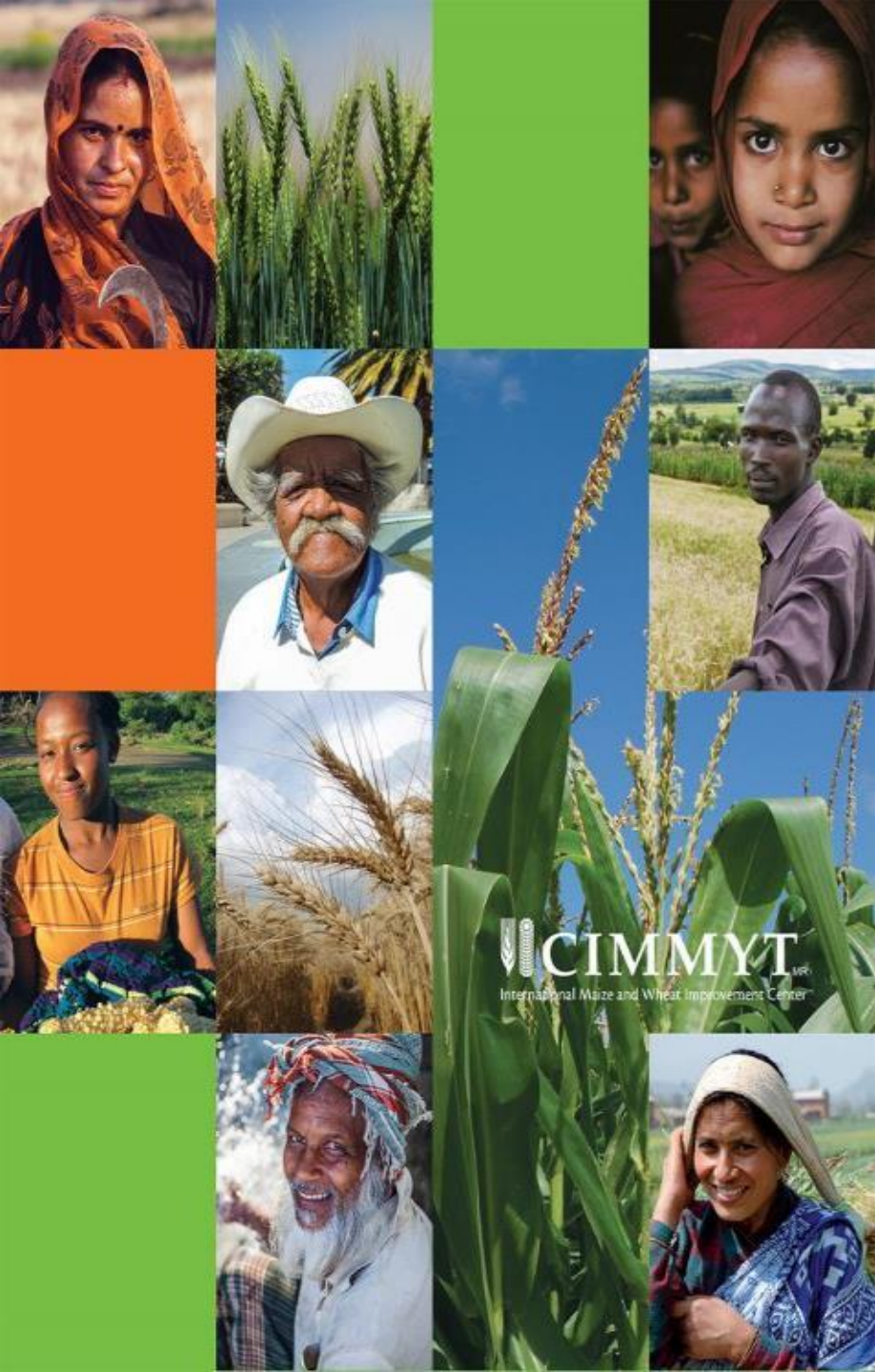


Successfully demonstrated for quality and yield traits

# Promising lines of CIMMYT-BISA will be evaluated against wheat blast at Bolivia & B'desh



**Look forward to  
strengthened  
collaboration**



**Thank you !**