Special Session:
UG 99 Status, Management and Prevention

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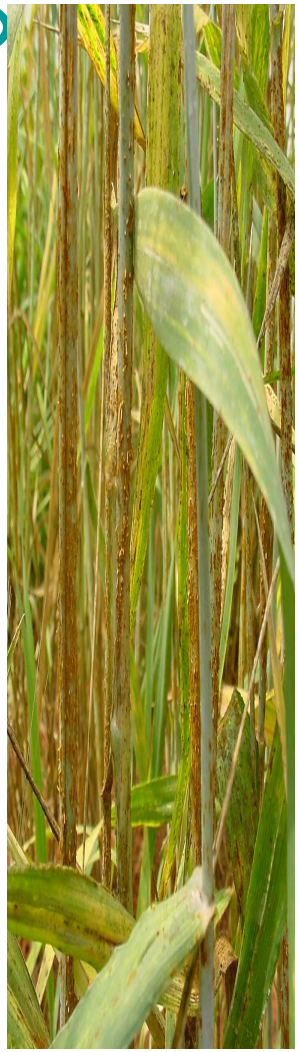
FAO, Rome 9 April 2008

Current Importance of Wheat Rusts

Region	Yellow Rust	Leaf Rust	Stem Rust
Australasia	Major	Local	Minor
East Asia	Major	Local	Minor
South Asia	Major	Local	Minor
West Asia	Major	Local	Minor
Central Asia	Major	Major	Local
Russia/Ukraine	Local	Major	Minor
Middle East	Major	Local	Minor
North Africa	Major	Local	Minor
Eastern Africa	Major	Local	Major
Southern Africa	Major	Local	Local
Eastern Europe	Local	Local	Minor
Western Europe	Major	Local	Minor
North America	Major	Major	Minor
Central America	Major	Local	Minor
South America	Local	Major	Local



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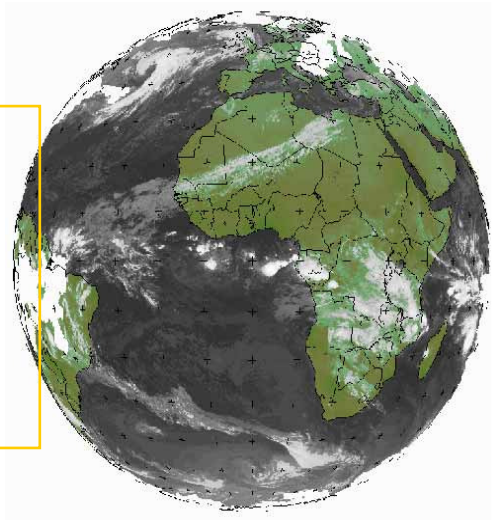
Trans-boundary wheat rust

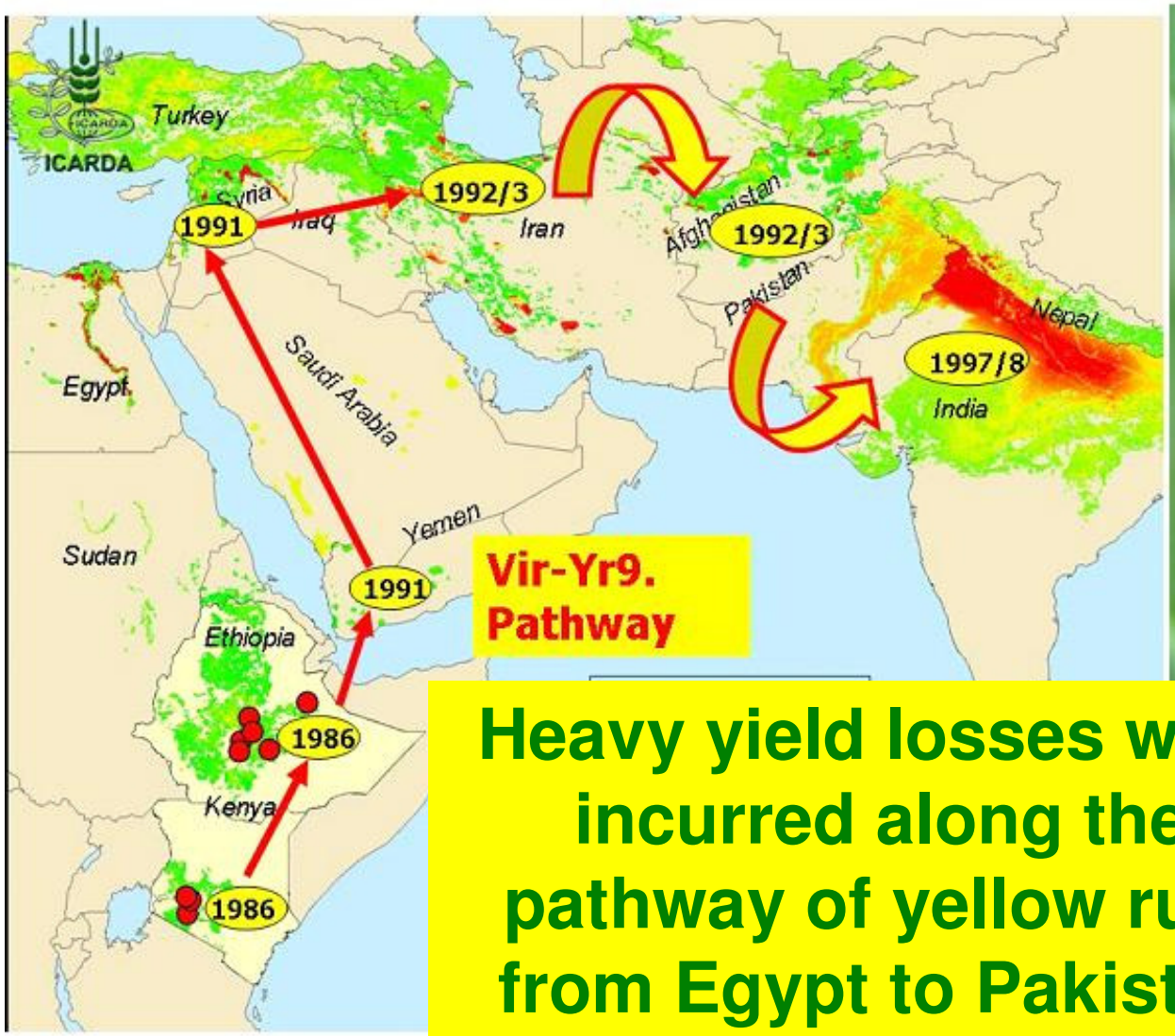
Historical information shows records of wind borne spores moving across continents, although shorter distance movements are more common – often within distinct pathozones (or epidemiological regions?).



Virulent strain of wheat stripe rust (*Puccinia striiformis*) referred to as Vir.Yr9, appeared in Kenya 1980 then was recovered in Ethiopia in East Africa in 1986, Pakistan and Nepal in 1990 and reached South Asia in 1993

Spread of Yellow rust followed prevalent current.

Yellow rust (Vir. Yr9) spread 1986-1998



Heavy yield losses were incurred along the pathway of yellow rust from Egypt to Pakistan

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Trans-boundary wheat rust

In 1999 a new strain of stem rust (*Puccinia graminis* fsp *tritici*) occurred in Uganda, known as Ug99 (www.globalrust.org).

**Ug99 represents a much greater threat than Vir Yr9,
Estimated 80% of current global wheat varieties are susceptible**

New Stem rust race: UG99

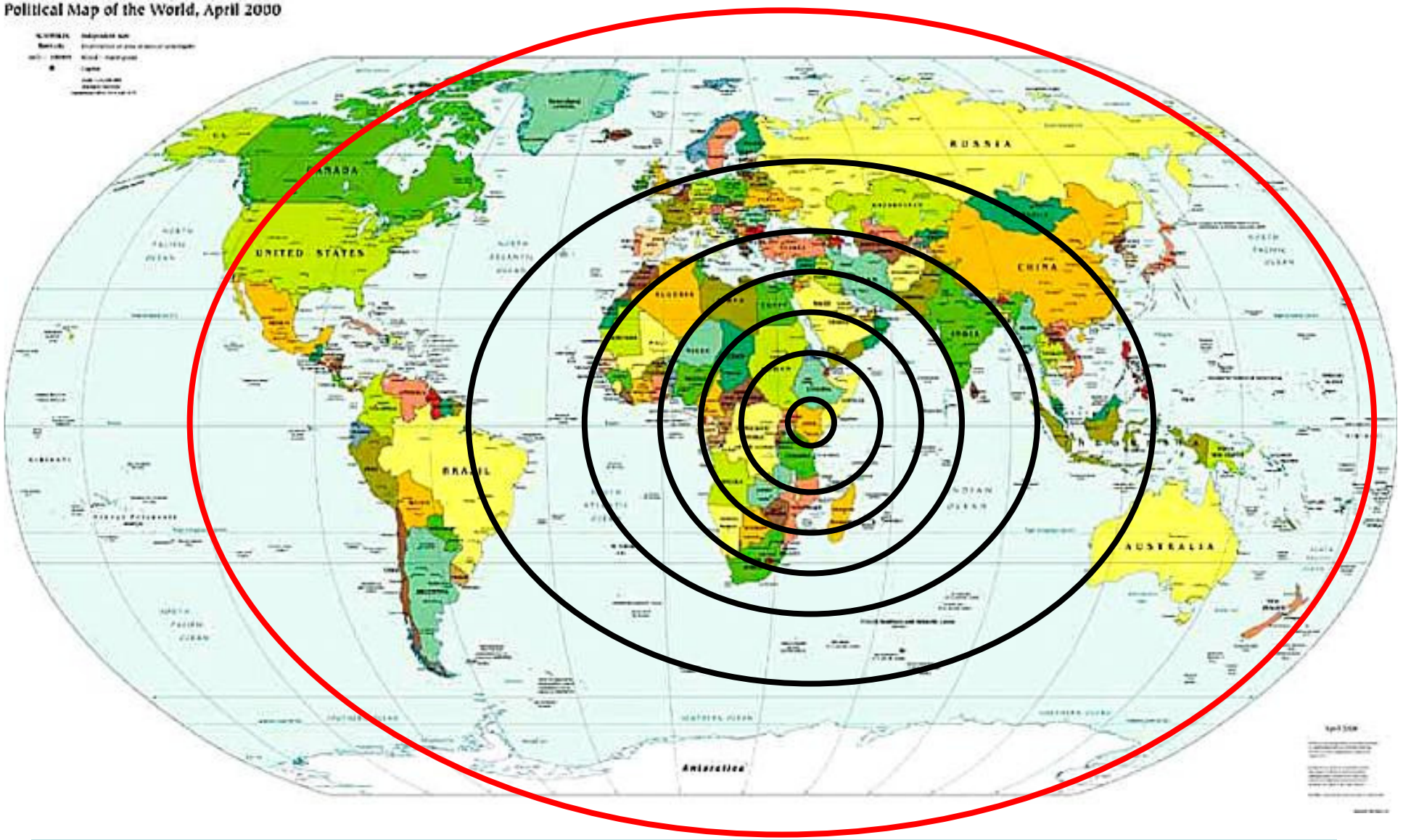
Stem rust Ug99 followed the expected migration but moved faster to Yemen

Ug99-TTKS

Ug99: Global threat

Can spread from East Africa to Asia, Europe, Australia, America

World wheat tsunami????



Such scary reach-out may increase the wheat price in the speculative global market. But who gains ? (Dr. S.Nagarajan-Rome meeting 3/6/07)

Global Rust Initiative-GRI

CGIAR

In 2005 Laureate Nobel Peace Prize, Dr. N.E. Borlaug launched an appeal to international community to combat The killer stem rust that emerged in Uganda in 1999 hence called Ug99

2005 Nairobi Rust Summit

CIMMYT, ICARDA, and World-wide Consortium heeded N. Borlaug's call by forming the Global Rust Initiative (GRI)

Reminder from the past: "If we fail to keep agriculture moving in the less-developed nations, poverty will continue to grow, and the social upheaval that will ensue will become a global nightmare" N.E. Borlaug 1970

Virulence Spectrum of Ug99

Origin	Resistance genes
Triticum aestivum	5, 6, 7a*, 7b, 8a, 8b, 9a, 9b, 9f, 15, 16, 18, 19, 20, 23, 28*, 29, 30, 41, 42
T. turgidum	2, 9d, 9e, 9g, 11, 12, 13*, 14*, 17
T. monococcum	21, 22, 35
T. timopheevi	36**, 37**
T. speltoides	32**, 39
T. tauschii	33**, 45
T. comosum	34
T. ventricosum	38
T. araraticum	40
Thinopyrum elongatum	24*, 25, 26, 43
Th. intermedium	44
Secale cereale	27*, 31, 1A.1R

Blue = effective (including moderate levels), Red = not effective,
Black = no data

* Virulence known to occur in other races

** New Virulence (Ye), 2008

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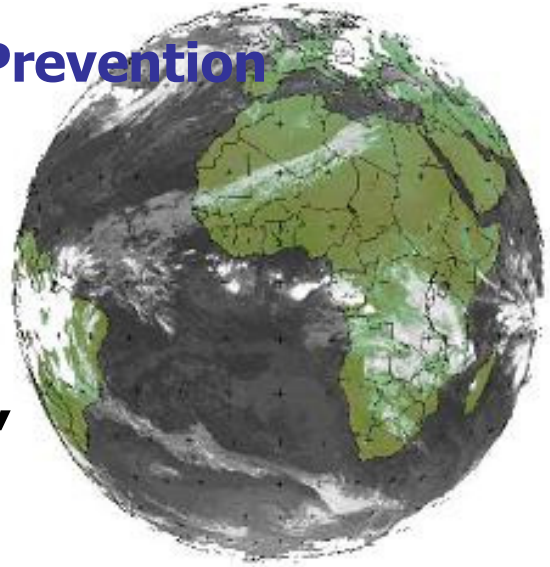
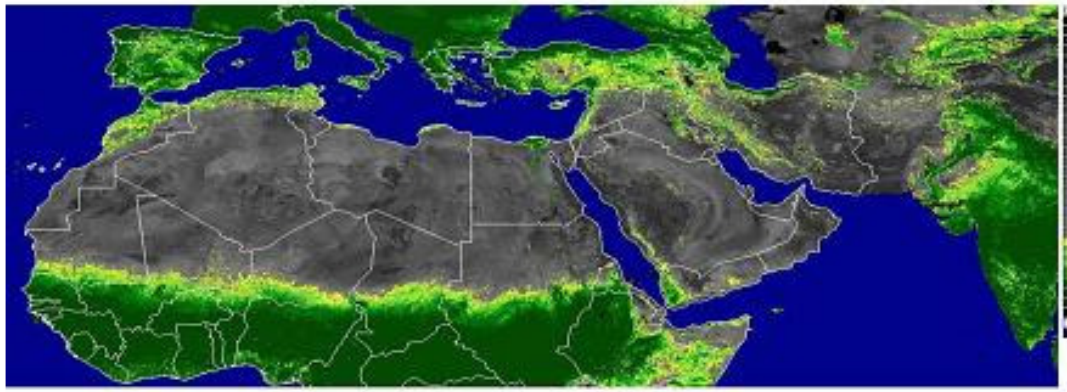
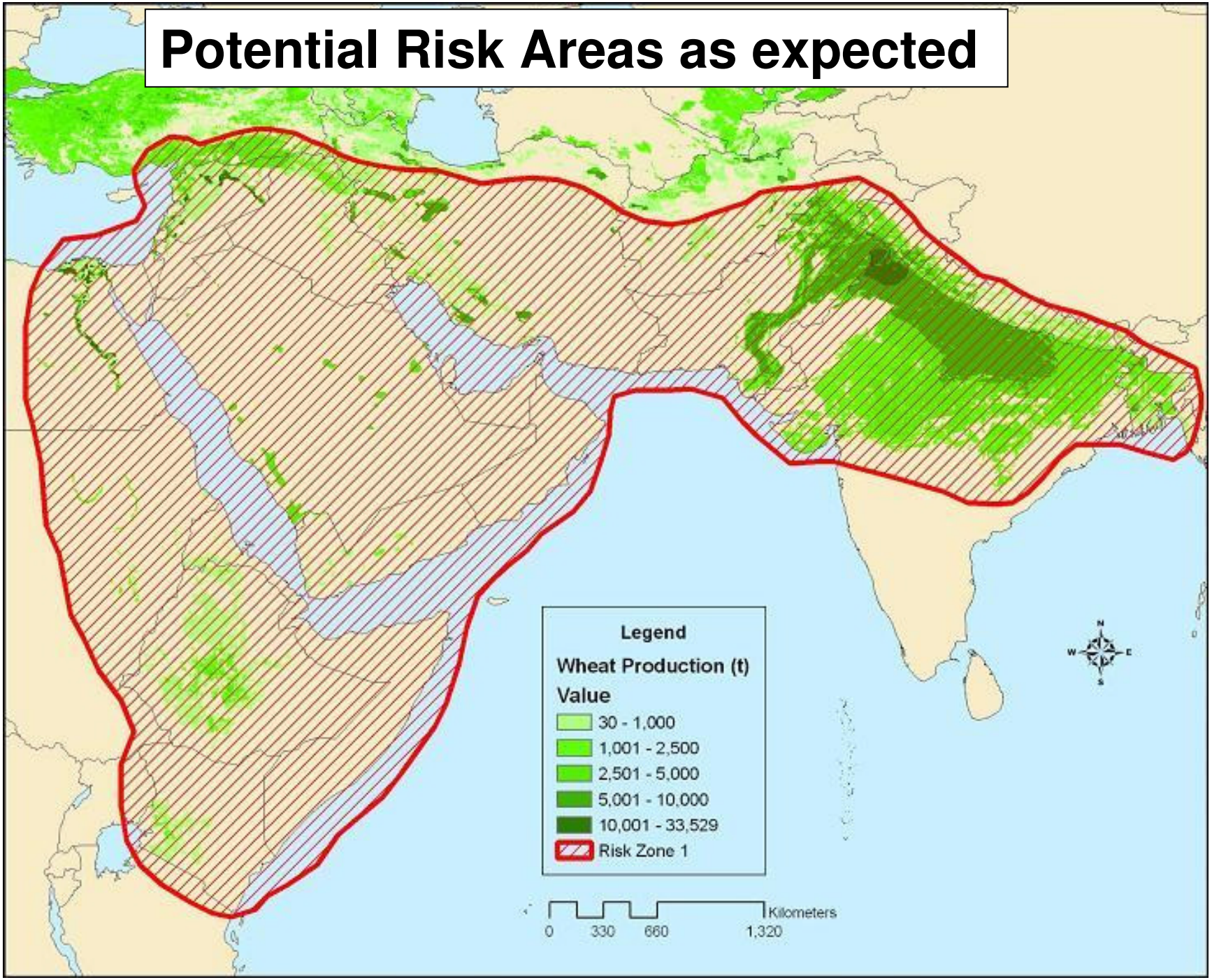


Trans-boundary wheat rust

With the long distance travel of rust spores, it is only a matter of time until Ug99 reaches across the Arabian Peninsula into the Near East, Mediter. region; and possibly eastern Europe, Russia, Central Asian countries, South Asia, East Asia North America, and Australia



Potential Risk Areas as expected



Ug99: Clear Danger in Central, West Asia and North Africa (WANA)

Approximate area affected by Ug99

- **CWANA** — **42 m. ha**
- **Subcontinent** — **36 m. ha**

Total — **78 m. ha**

- **Approximate production (Estimated)** — **170 m. t.**
- **Southern Europe very Vulnerable**

Approx. losses could reach 17 m.t equivalent to more than 15 billion US$ ***(current wheat price)***

Identification of Sources of Resistance to Stem Rust Race Ug99

Identification of current and retired wheat varieties and breeding lines with resistance to Ug99 will provide:

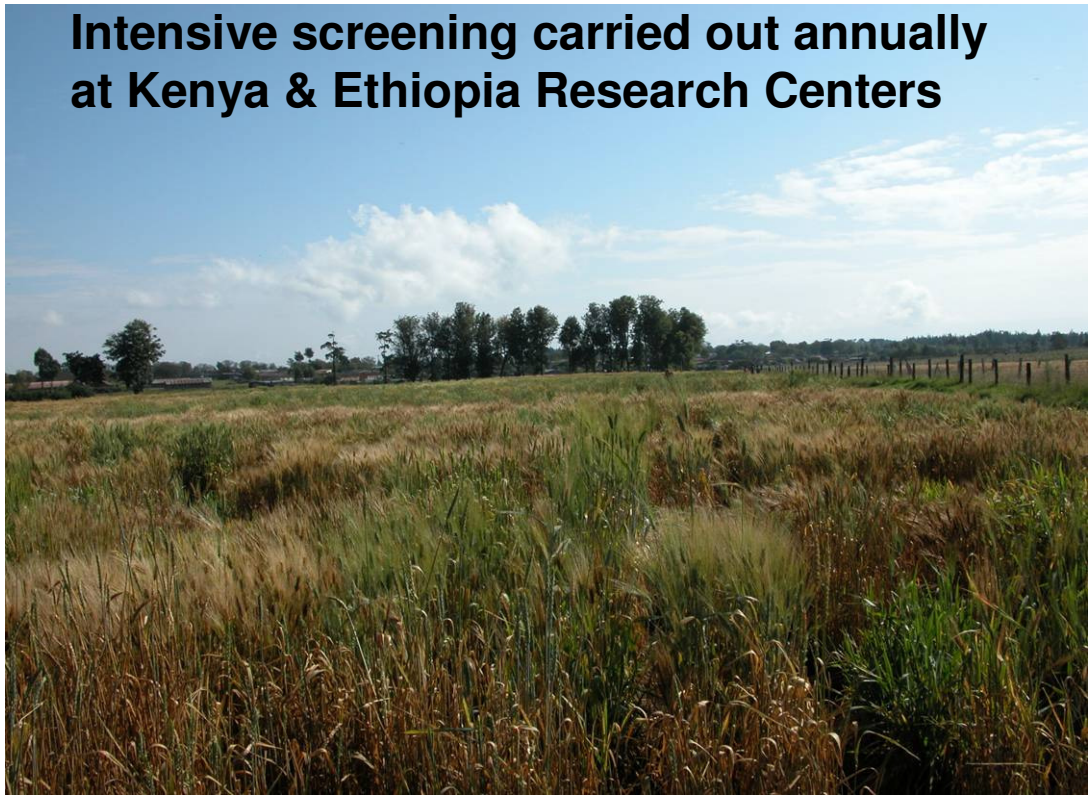
Alternatives for emergency replacement of susceptible varieties

Possible discovery of as of yet unknown resistance genes (both race specific and non-race specific, e.g., slow rusting)

Evaluation of breeding lines for resistance to Ug99

Screening at Njoro-Kenya (2006)

Country	Tot	R/MR	S
Bangladesh	**84**	3	81
China	**118**	2	116
Egypt	**149**	**3**	146
India	**102**	23	79
Iran	**100**	**2**	98
Kazakhstan	**86**	3	83
Nepal	**105**	2	103
Pakistan	**105**	**6**	99
Russia	**35**	1	34
Turkey	**85**	16	69
CIMMYT	**886**	226	660
ICARDA	**1518**	65	1453
Total	**3372**	**352**	**3021**



Levels of resistance to Ug99-07

Over 6000 accessions tested

- ✓ **25% : CIMMYT-ICARDA**
- ✓ **<2% NARS Res.Ug99**

Accelerated Seed Multiplication

Berkume (Millennium). ETBW 4921:

ALD/CEP75630//CEP75234/PT7219/3/BUC/BJY/4/..

First year-Two crop seasons at Kulumsa, Ethiopia:
(26 tons of seed produced from initial 8 kg)

- ✓5 tons distributed to 300-500 small farmers (10-15 kg/each) at high risk area
- ✓10 Tons of seed will handled by NGO's in remote areas not covered by ESE
- ✓10 tons multiplied by Ethiopian seed Enterprise (ESE)

Second year: Seed collected from previous recipients

- ➢114 tons available for planting –Main season in 2008

ICARDA

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Berkume Released in Ethiopia in 2007

Carries Sr.24 resistance gene
Sr.24 defeated by Ug99 variant in Kenya (2007)
Sr.24 virulence not detected in Ethiopia

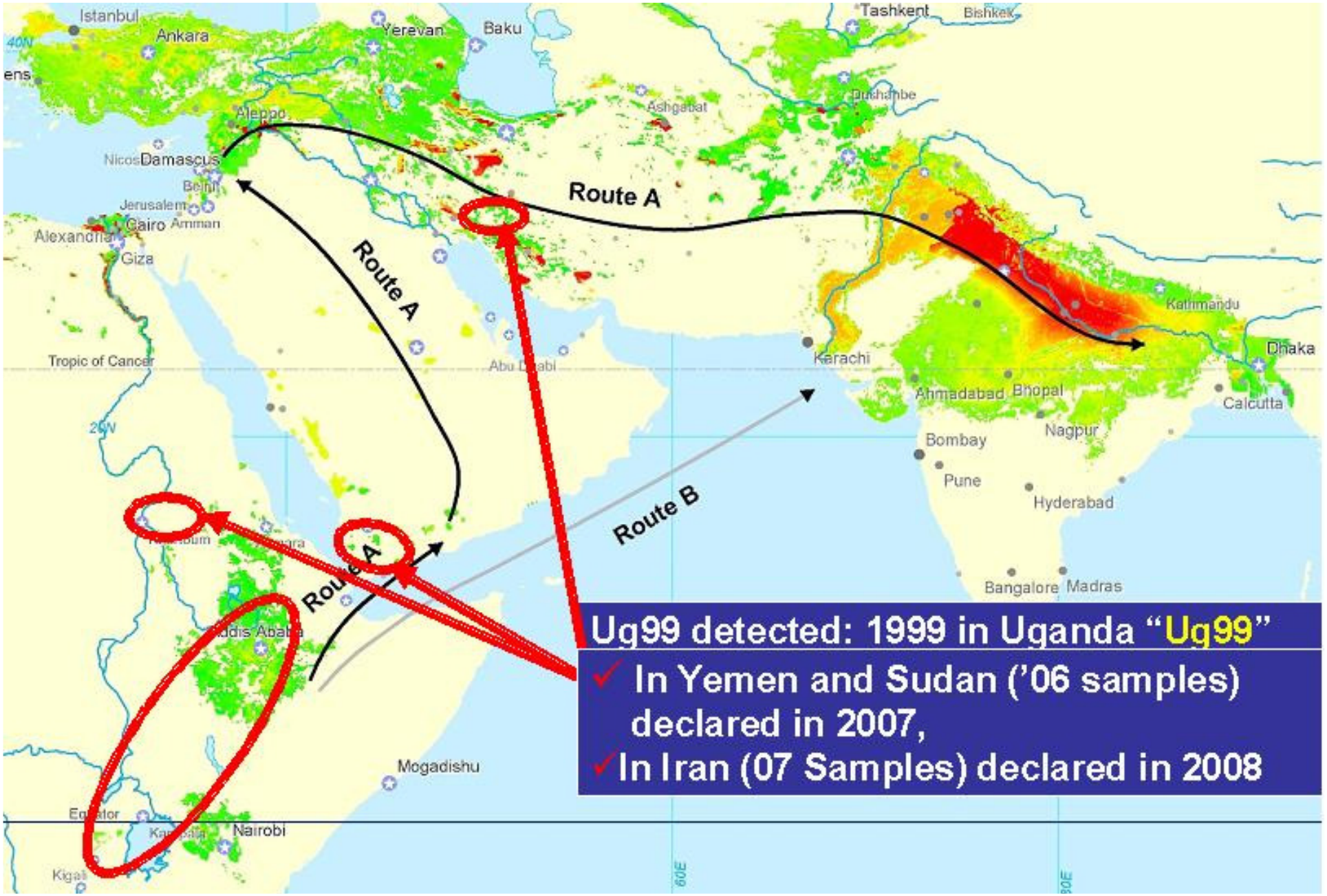
Eleven ICARDA bread wheat lines under testing in Ethiopia are being multiplied for further seed increase

Selected lines will be recommended for release in Ethiopia, Eritrea, Sudan, and Yemen

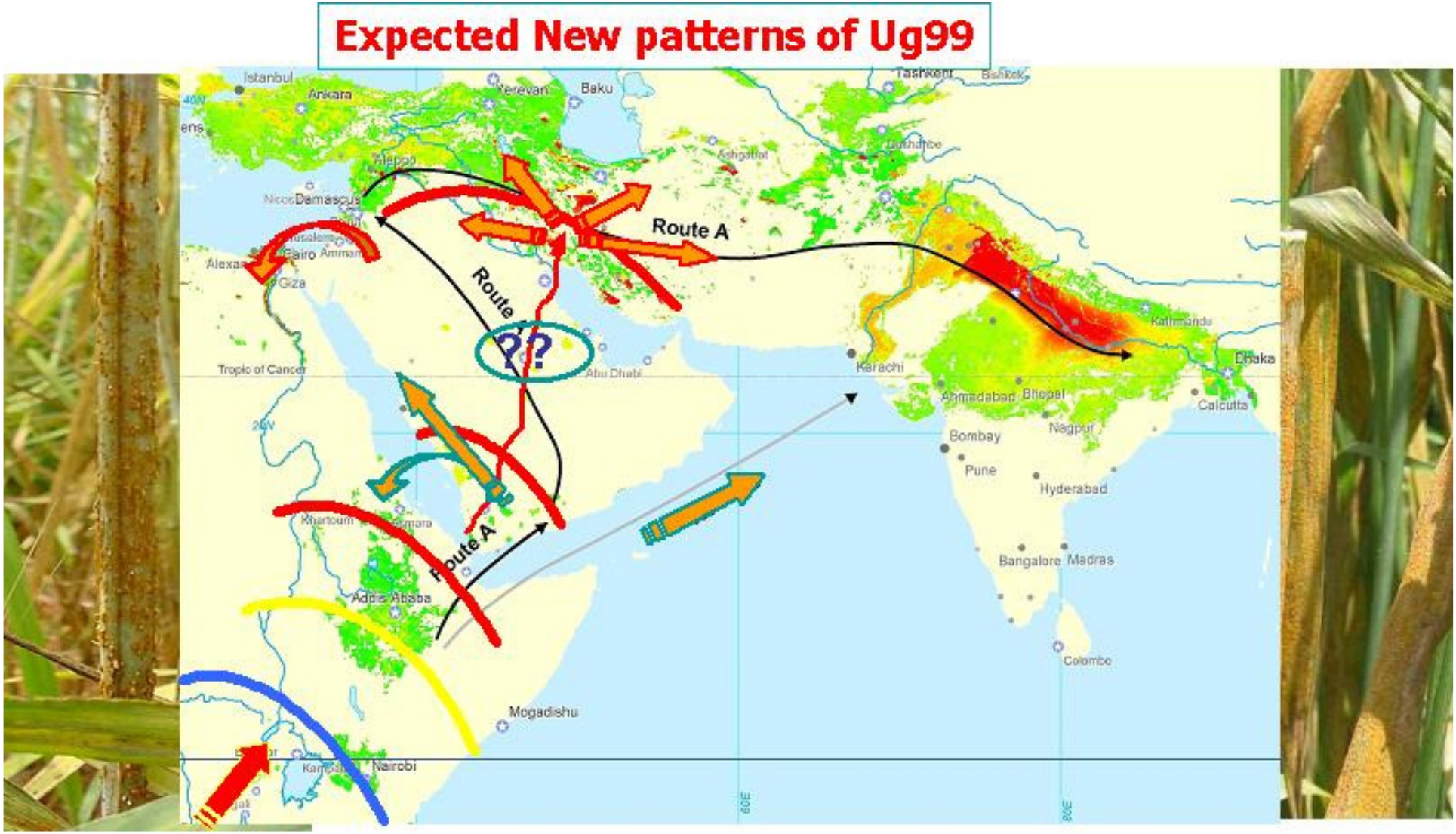
Twenty advanced bread wheat lines selected for durable resistance by CIMMYT and tested in Kenya, Ethiopia, and Yemen

Selected lines be evaluated by NARS in CWANA for yield performance, and eventual release within the next 3 years

Occurrence and Movement of Ug 99-TTKS



Occurrence and Movement of Air borne Pathogens



Air borne diseases such as rusts are transboudary

- **Have no restriction on their movement-Air borne**
- **Not quarantine disease-Regional& Global Monitoring**

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Current and Future Plans in wheat rust Management and Prevention

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Current activities in wheat rust Management and Prevention

Current and Future Plans in wheat rust Management and Prevention

1. Disease Surveillance:

- Regular national wheat disease surveys (incidence and severity of rusts)
- Race analysis and virulence change monitoring
- Field rust trap nurseries

Importance of having both national agricultural research systems (NARS) and plant protection units of the MoA

Capacity and infrastructure building

2. Breeding for durable resistance:

- National breeding programmes
- CG-Centers breeding programmes
- Advanced research institutes and universities

International screening nurseries in already infected areas (Kenya)

Capacity building

Current and Future Plans in wheat rust Management and Prevention

3. Seed multiplication and distribution:

- Identification of resistant varieties and testing them nationally (even if they are not the highest yielding)
- Identification of most efficient national seed multiplication system (public, private, informal, NGOs,...)
- Seed distribution system to the most vulnerable farmers

  Importance of updating information on virulence shifts and movement of pathogen

  Capacity and infrastructure building

4. Support to field management activities:

- Changes in planting dates, delayed planting
- Use of varietal mixtures and patch planting
- Use of short duration varieties
- Use of fungicides under very serious conditions

  Capacity building

Current and Future Plans in wheat rust Management and Prevention

FAO is now a full partner in GRI (now BGRI and also includes Cornell University)

FAO's role and comparative advantage

- **Support in surveillance and monitoring systems:**
  - **Experience in Desert Locust Management**
    Adaptation of DL model for rust surveillance

  Initiate rust monitoring system at AGP

- **Direct working relationships with Ministries of Agriculture (especially the national plant protection services)**

  Reinforce Research-Plant protection working relationships

- **FAO experience in risk management**

  Support national contingency planning

FAO's role and comparative advantage (cont'd)

- **Experience in National Seed systems**
  - **Work on national regulation and regional harmonization of regulation for seed exchange**
  - **Work with formal public and private and informal seed sector**
  - **Capacity building in seed quality production**
  - **Work in emergencies and rehabilitation**

    Reinforce CG-Center activities in replacement seed multiplication and distribution

- **Experience with participatory work with Farmers**
  - **Network of trained farmers and Farmers Field School (FFS) Facilitators in the Ug99 risk region**
  - **Trained farmers in rational decision making and ecosystem analysis**

    Support in the implementation of national contingency plans

- **Hosting of key International Instruments (IPPC, International Code of Conduct on the Distribution and Use of Pesticide, IT-PGRFA)**

  Support to countries in policy options

Surveillance of wheat rusts

Successful program of tracking wheat rust pathogens is being implemented by ICARDA & CIMMYT and will be reinforced by FAO & Cornell University (BGMF)

The objective will be to integrate surveillance system into national and international entities tasked with tactical and strategic risk management and interventions in response to biosecurity threats

Success will result in routine exploitation of the global surveillance data using the spatial, temporal, and evolutionary dynamics of wheat rusts (unit to be initiated at FAO)

Surveillance of wheat rusts

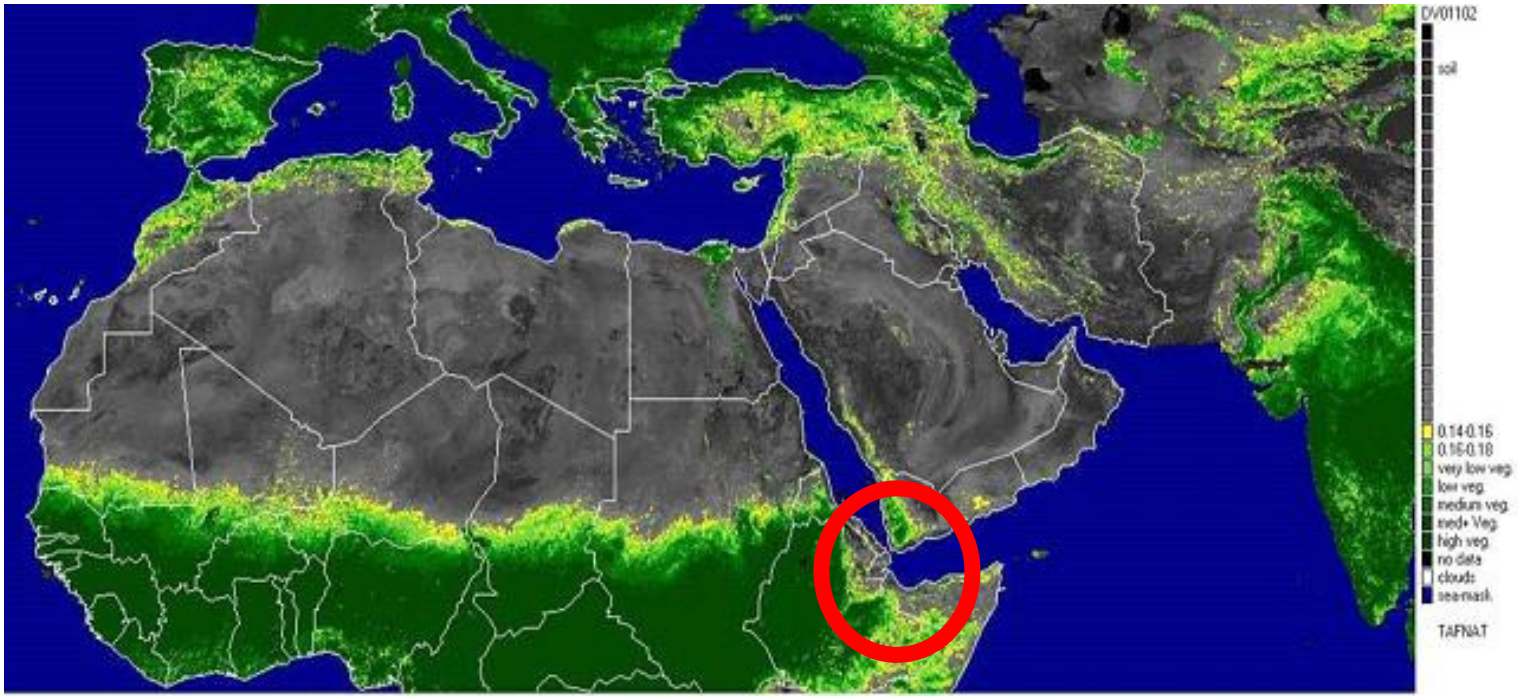
- Wheat disease survey in the field (using GPS)
- Race identification from field survey samples
- Rust trap nurseries distributed in all countries

Further information needed (for risk assessment)

- Wheat cultivation maps (national and regional)

Cereal Rust Monitoring- Green Bridges

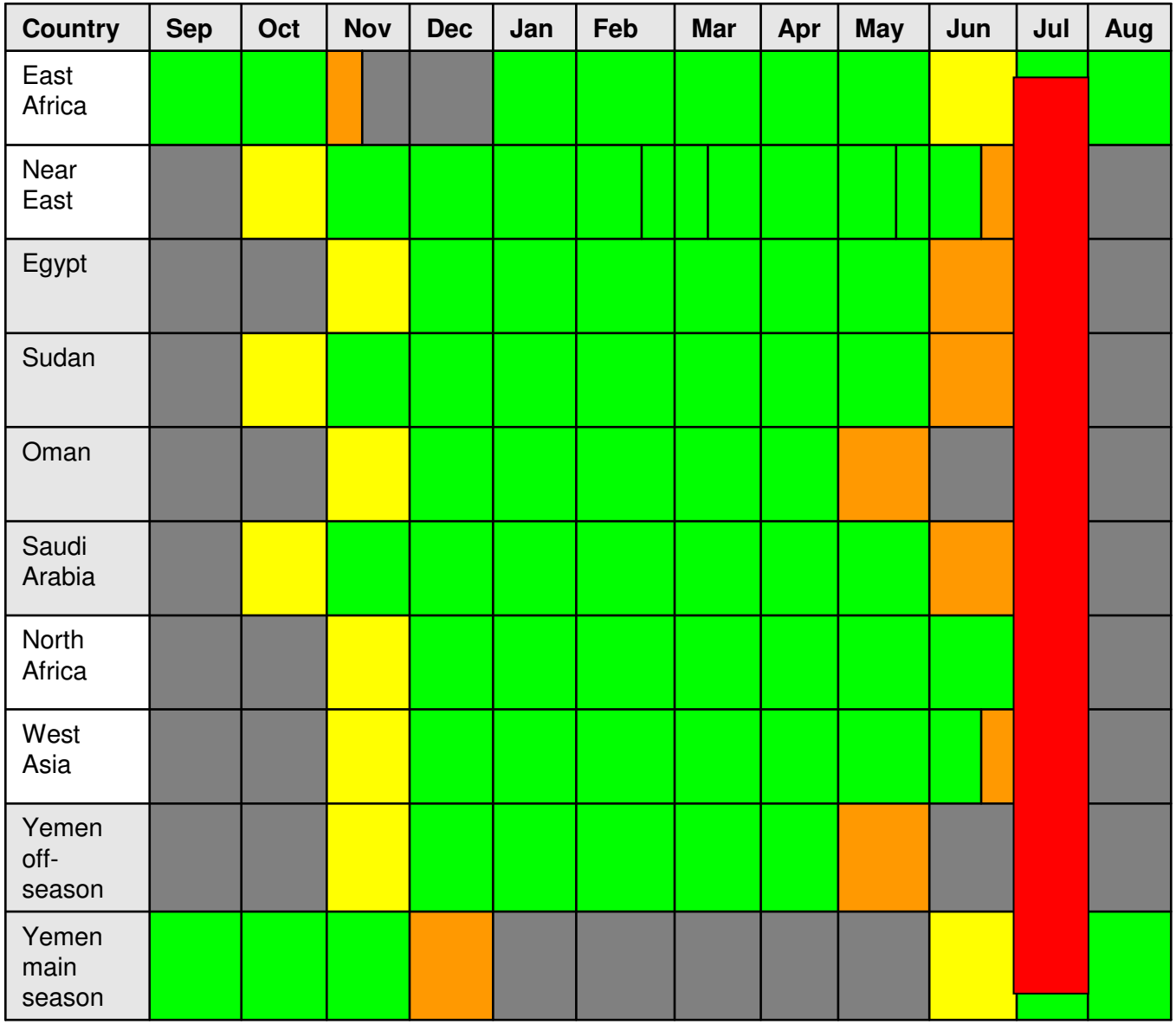
Key measures to avoid/avert current and future rust spread and prevent epidemics could be achieved through better understanding of the passive movement of air-borne pathogens at the horn of Africa



- ✓ **Adequate monitoring**
- ✓ **Green bridge adjustments**
- ✓ **Prevalent wind current & Rust spread**

Yemen Gate for RUSTS links East Africa to Arabian Peninsula, South Asia, and beyond

Cereal Rust Monitoring- Green Bridges



Can we make a free wheat period In East Africa & Yemen

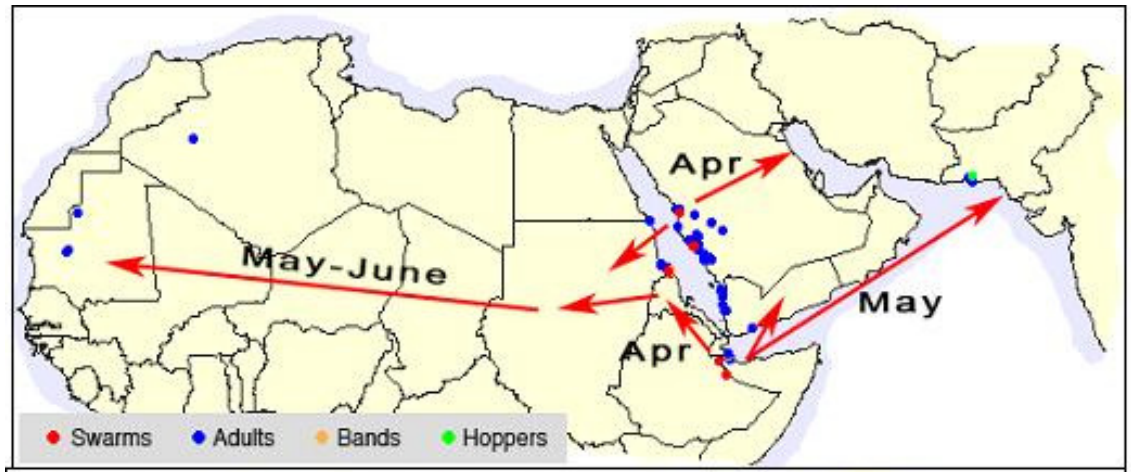
Legend:

Planting period	
Growing season	
Harvesting period	
No Wheat crop	

FAO Locust Early Warning System is relevant to wheat rusts

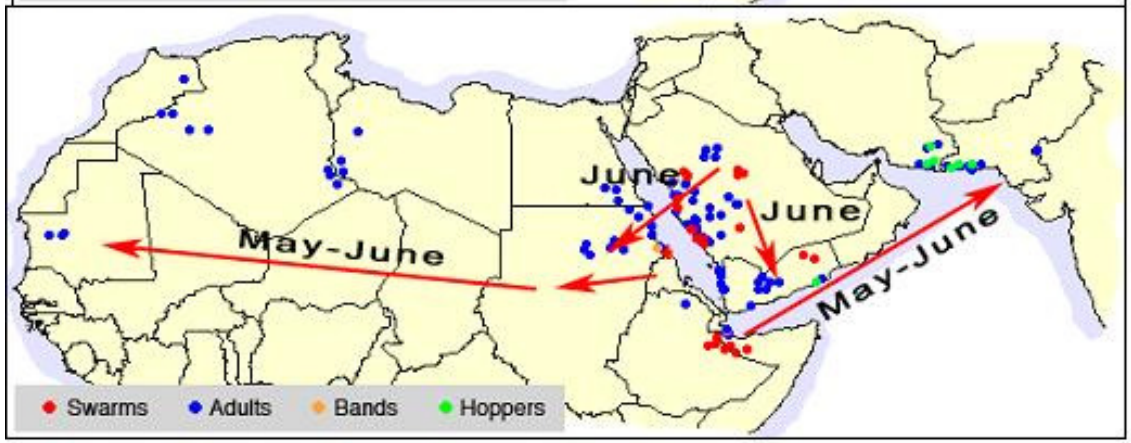
Locust and rust have common features

- Transboundary
- Move with the winds
- Occur in the same region



Desert Locust Forecast

27 April 2007



Desert Locust Situation

3 May 2007

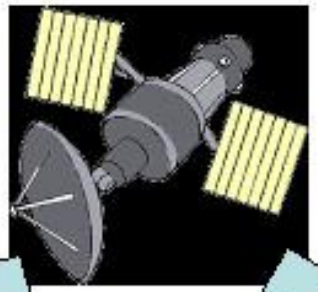
http://www.fao.org/ag/locusts

Locust data collection & transmission

- ✓ Years of experience
- ✓ Quality of data - good partnership
- ✓ Timely communication
- ✓ National interest
- ✓ Good support from MoAs

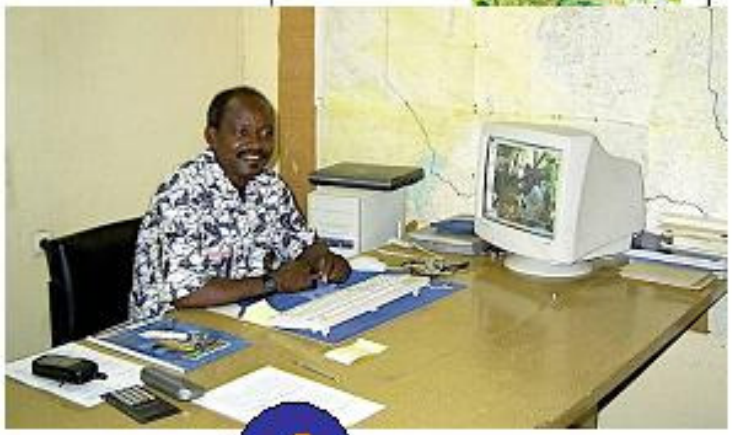
1 survey

2 eLocust2



3 via satellite

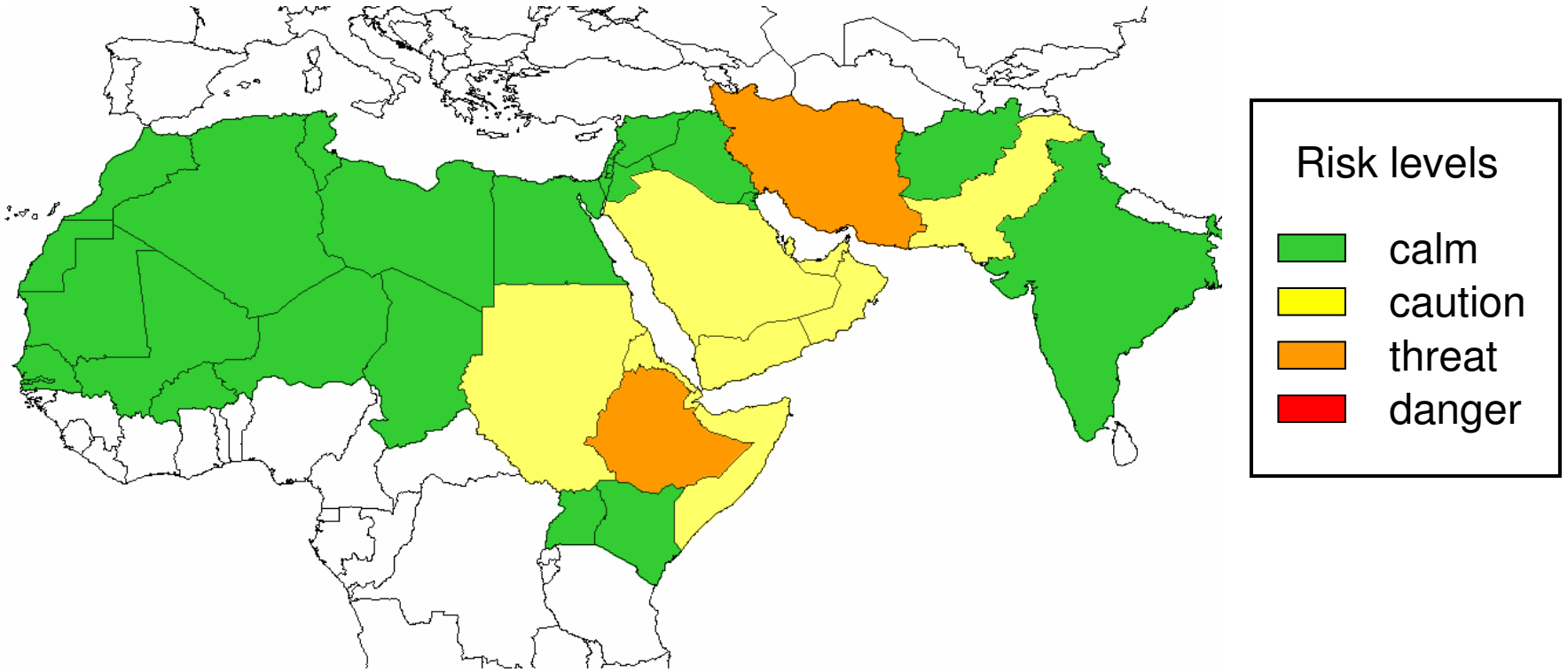
GIS



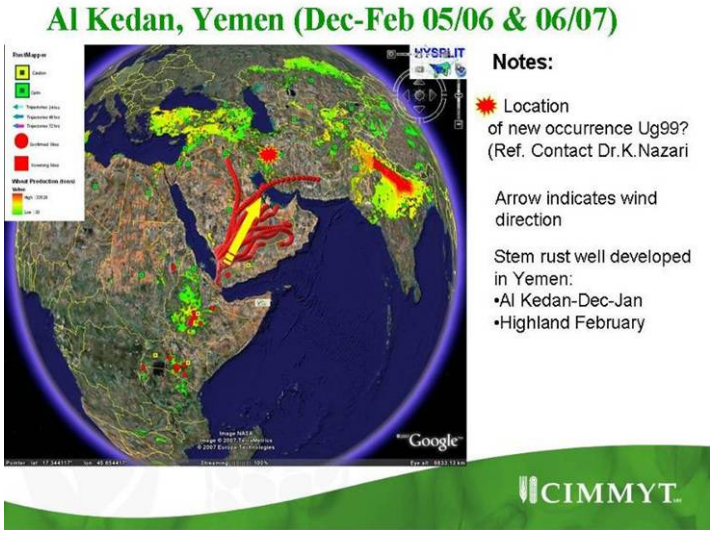
4 National Focal Point

Outcome: Timely forecasting - Risk aversion/reduction

- ✓ **simple** and **rapid** exchange of information
- ✓ **timely** situation updates
- ✓ **color-coded** Risk Levels
- ✓ **planned** intervention & National/Regional **action taken**



Wind Currents: Rust spores - air borne, passive transport

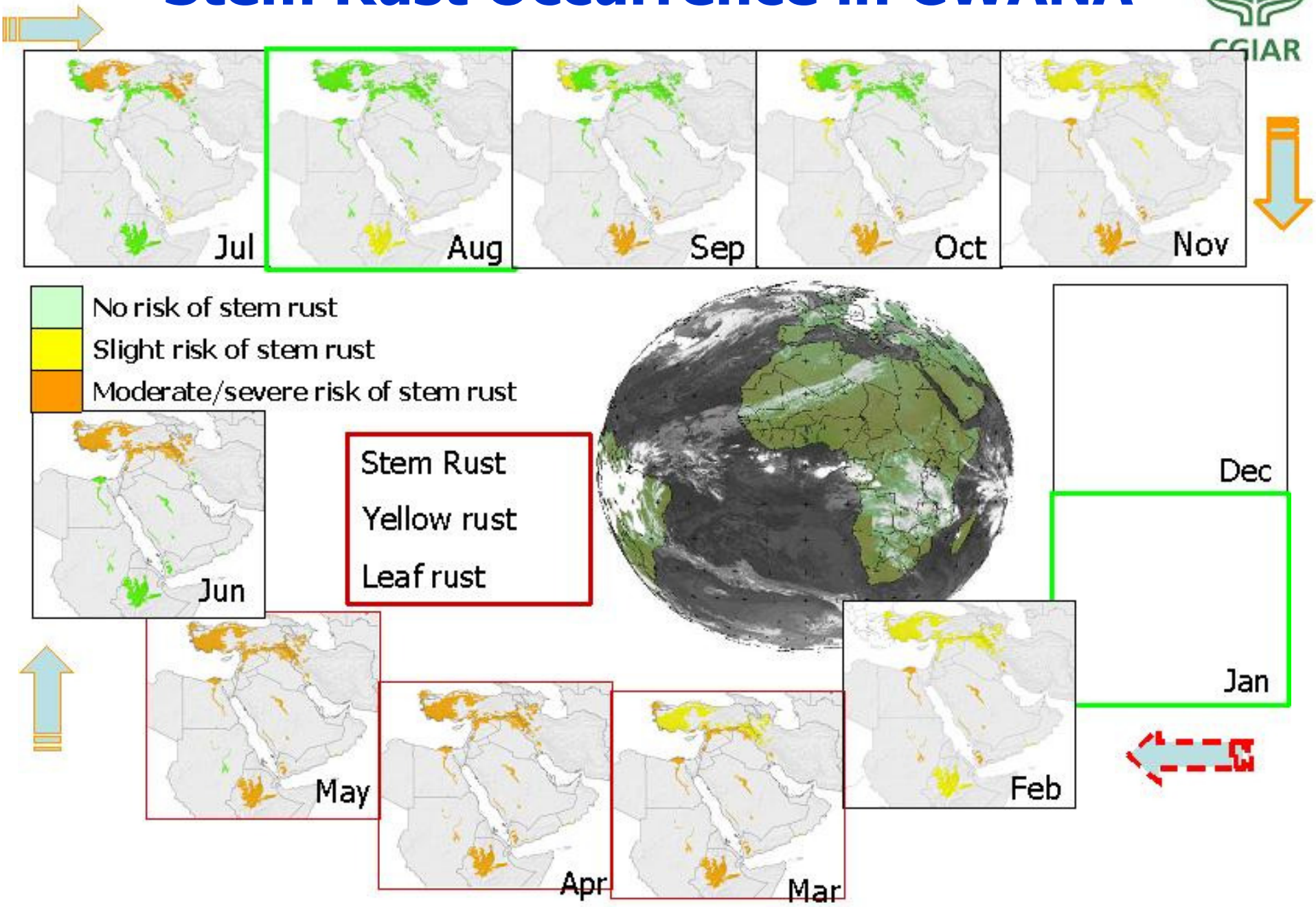


Rust mapper

GIS-Support

D.Hodson, CIMMYT
E.De-Pauw, ICARDA
K.Cressman, FAO

Stem Rust Occurrence in CWANA



Further actions to be taken in wheat rust Management and Prevention

Current and Future Plans in Wheat Rust Management and Prevention

Varietal replacement and breeding strategies

- Urgent replacement of susceptible varieties at high risk countries
- Encourage release of resistant/tolerant cultivars (durable resistance)
- Encourage diversification of available varieties
- Enhance seed multiplication (use most efficient system)

Reduction/elimination of rust inoculum (spore masses)

- Encourage planting of early maturing varieties
  - *plant downwind reducing risk of inter-seasonal cross field contamination*
- Eliminate/avoid green bridge
  - o*verlapping of wheat crop: several planting dates, spring and winter wheat*
- Delay fall planting (WANA)
  - *Avoid winter planting (December-January) of susceptible varieties*
  - *Delay summer planting (East Africa)*
- Eliminate volunteer wheat/grasses before emergence of main wheat crop

Current and Future Plans in Wheat Rust Management and Prevention

Create patchwork: Strip planting, landscaping

- **Plant strips of different varieties or even different cereal species**
- **Consider varietal mixture *(similar genotypes with different resistance levels***

Fungicide application at hot spots

- **Cases where Ug99 confirmed-avoid further spread**
- **High productive crop where high risk of yield loss expected**
- **Assuring national rust fungicide registration**
- **Assuring the availability of sufficient fungicide quantities**
- **Rational plan for fungicide application to avoid abuse and resistance,…)**

Immediate Actions

- **Improving NARS Research Facilities**

  Accelerate varietal release systems (update/improve national catalogues)

  Enhance/strengthen national seed production systems

  Support rust pathotyping capabilities in Ethiopia, Kenya, Egypt, Turkey, and Iran others as need arises

- **Re-enforce Training Programs**

- **Establish/Strengthen inter-institutional links and coordination (Research-Extension-Plant Protection)**

- **Institutionalize the annual national pest and disease surveys**

Borlaug Global Rust Initiative-BGRI Donors

Current Funding

- USAID, USA
- CIDA, Canada
- ICAR, India
- AFSED
- BMGF

Expected funding

- FAO
- CG-Centers
- IFAD

Today's Children are tomorrows future farmers for whom we are building a brighter future