FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

BOARD FOR INTERNATIONAL FOOD AND AGRICULTURAL DEVELOPMENT
BIFAD

Practical Applications of Research Results

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Together, we build
international partnerships for
fruit and vegetable research that
improves livelihoods in developing countries.

Lessons Learned from Scaling Technologies

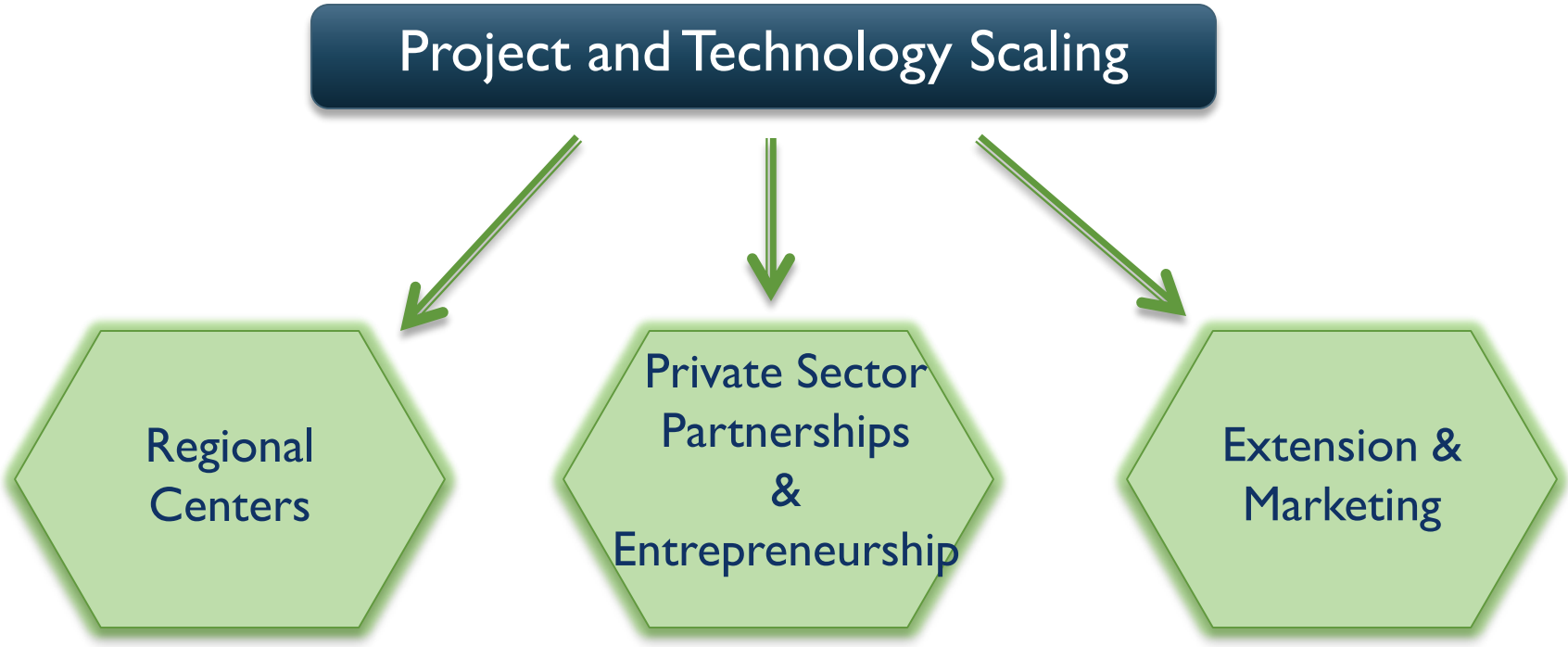
Dr. Elizabeth Mitcham, Director
Feed the Future Innovation Lab for Collaborative Research on Horticulture

USAID FROM THE AMERICAN PEOPLE
HORTICULTURE INNOVATION LAB
UCDAVIS UNIVERSITY OF CALIFORNIA

About us

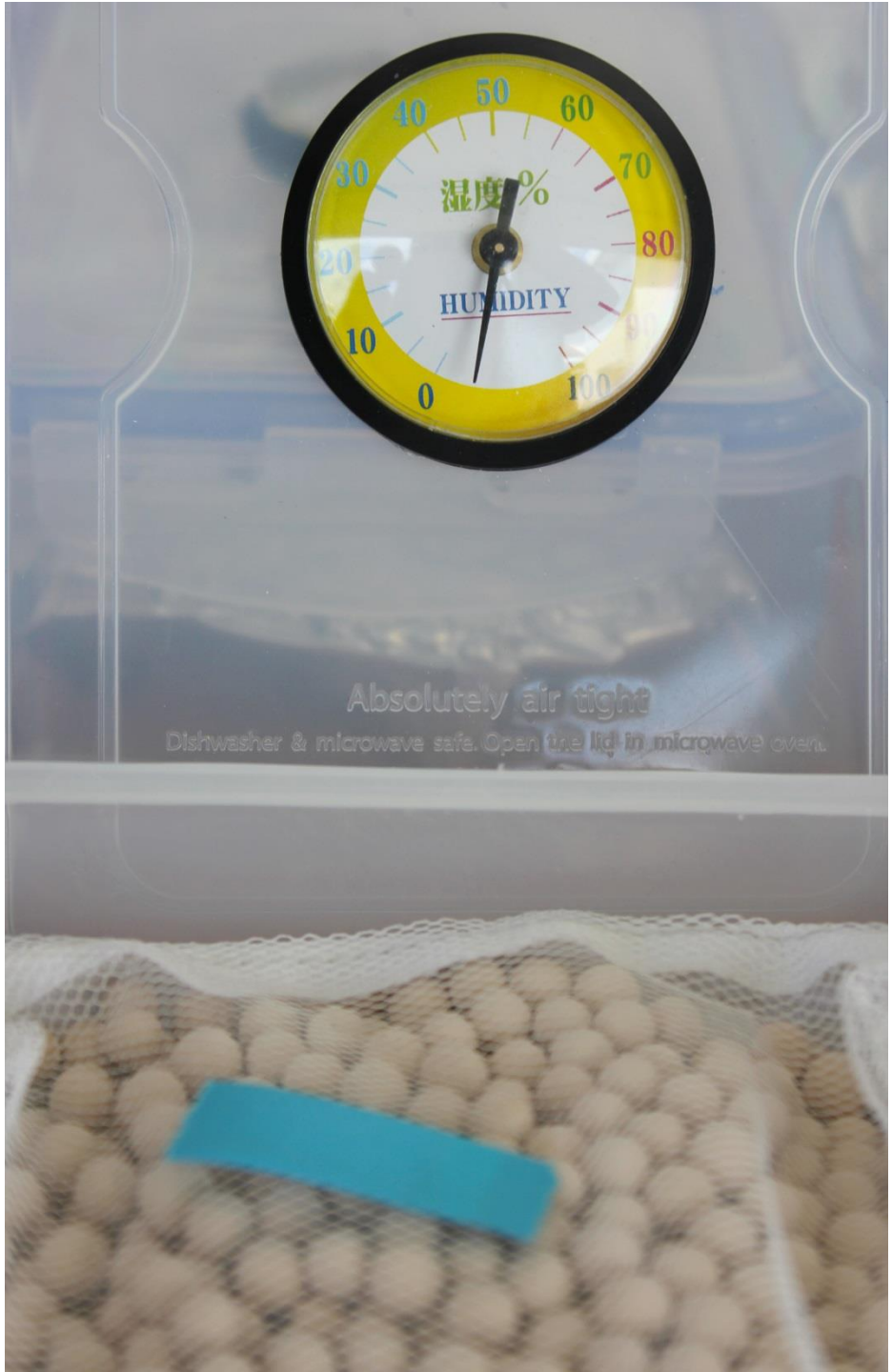
Our projects address:

- Production and marketing issues
- Creating better seed systems
- Reducing postharvest losses
- Improving extension and transferring innovative technologies


Project and Technology Scaling
Regional Centers
Private Sector Partnerships & Entrepreneurship
Extension & Marketing

Drying Beads Maintain Seed Quality

UC Davis Researcher Dr. Kent Bradford demonstrates the benefits of drying beads to maintain seed quality



- Can dry products to very low moisture content
- No mold, aflatoxin production or insect damage

- Dried vegetables and fruit
- Spices
- Dried groundnuts

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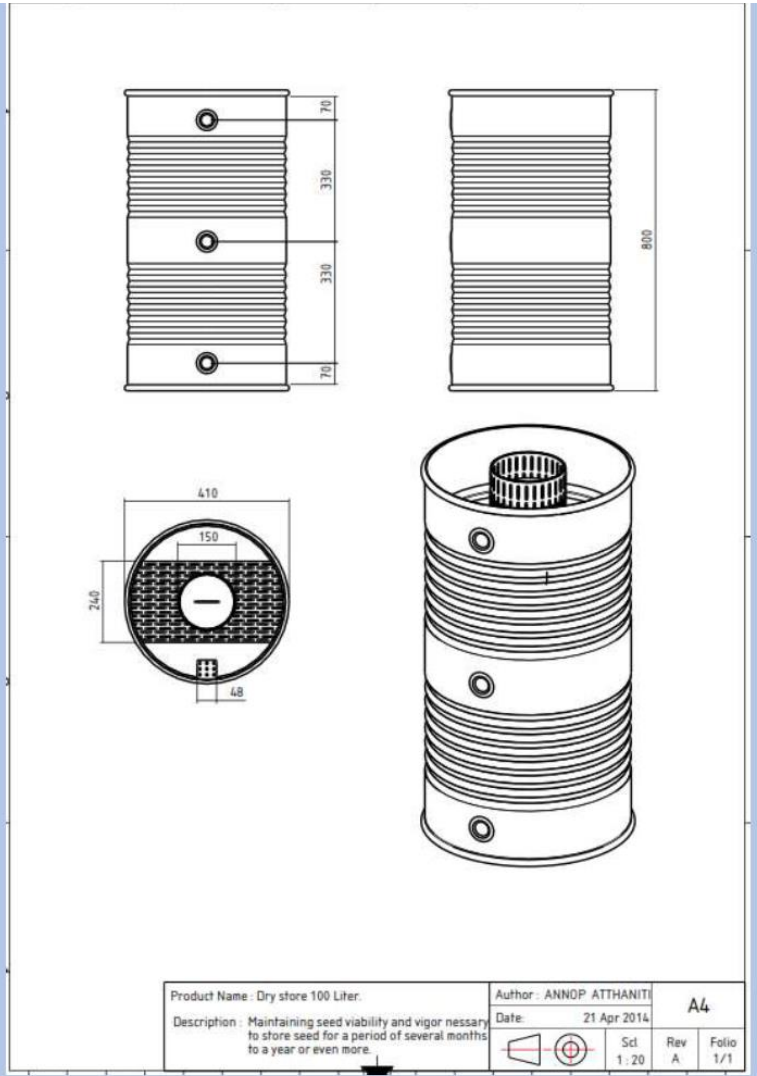
Drying Beads for Moisture Removal

- 1.6 liter DryBox
- 8.0 liter DryBox
- 16.0 liter DryBox
- 50 liter DrumDry
- 100 liter DrumDry



Lessons Learned Scaling Drying Beads

- Target beneficiaries: Who stands to directly benefit from the technology?
- Uses for technology have expanded
  - Seed producers, seed banks, spices, groundnuts, essential oils, energy savings
- Developing business models
  - Model for the developing world is different from US
  - Competing interests; how to keep focus on developing world
- Funding further scale-out
  - AgLearn project (USAID Asia-Winrock) providing assistance in finding local distributors
  - Bridge funding to develop franchise model in developing countries

DryCard™ Moisture Sensor

- Based on changing color of cobalt chloride impregnated paper with relative humidity
- The DryCard™ is a simple, inexpensive visual tool to raise awareness about the level of dryness of any dried food.
- Can be reused indefinitely!

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Supporting Entrepreneurs through a Franchise Model to Produce DryCards

- Spreading the word – won technology competition
- Identify interested parties through our trusted networks
- Providing starter materials to set up manufacturing and technical support
- Providing a simple and inexpensive technology in local languages helps with adoption.
- U.S. interest from Master Food Preservers, K-12 schools

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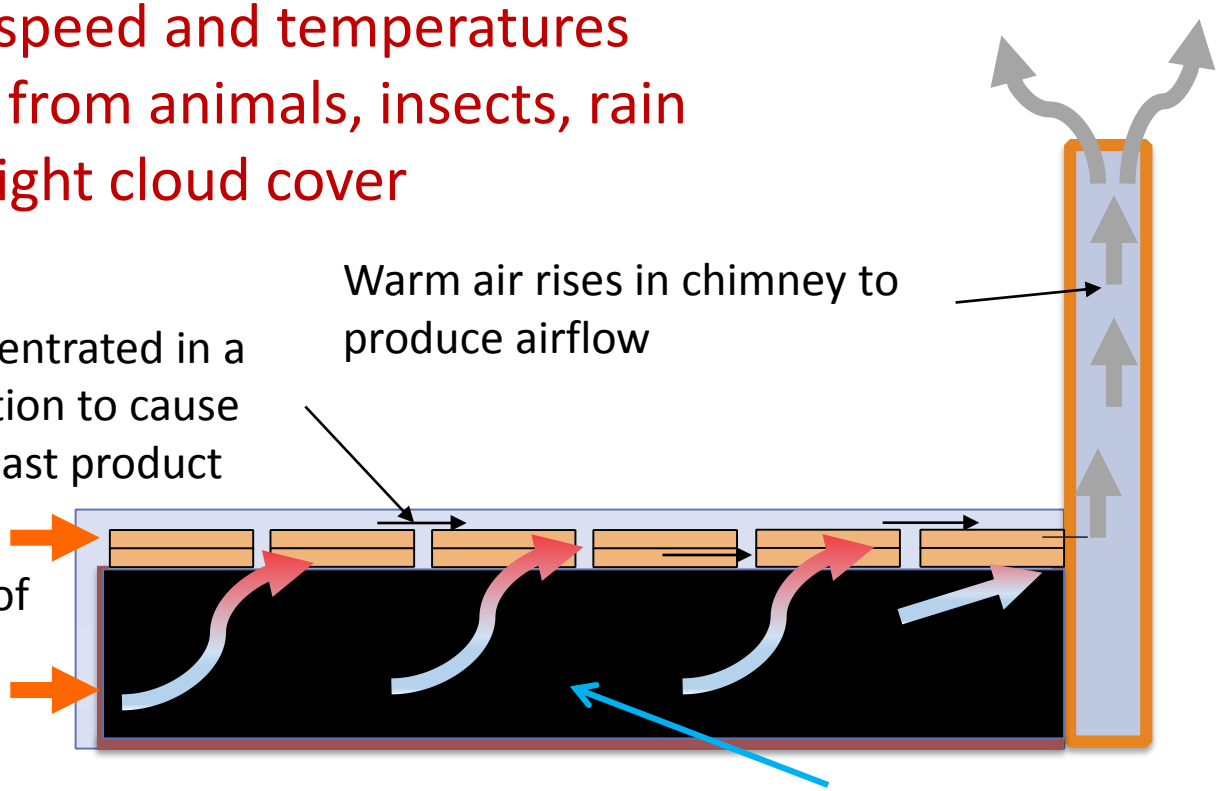
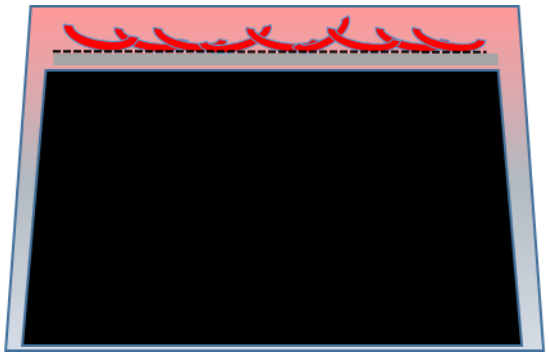
The Chimney Solar Dryer Concept

- Higher airspeed and temperatures
- Protected from animals, insects, rain
- Works in light cloud cover





60 cm high 'table' covered with black plastic or cloth. Clear plastic film is placed over the trays and the sides of the table.

Tested and Adopted

- Farmers/households
- Other USAID and Hort Lab Projects
- NGOs

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Lessons Learned in Scaling the Chimney Dryer

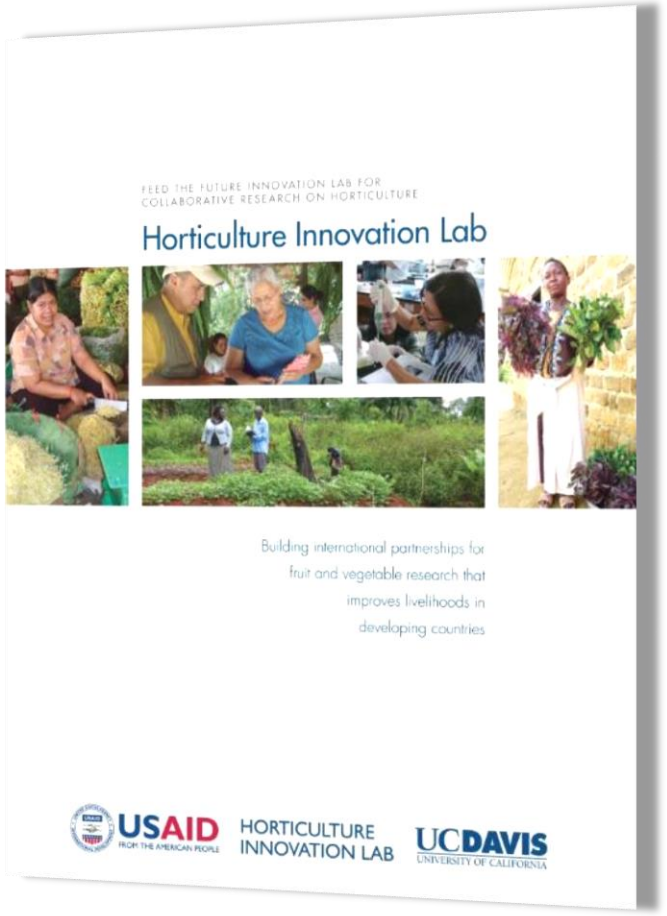
- Design is simple but not that simple
- Need a good manual for how-to-build and how-to-use the dryer
  - Simple enough to digest and understand
  - Detailed enough to build correctly
- Video showing construction details

https://ucdavis.box.com/s/lxwsy71elqjvko3ux61a4zj839nbs0t7

Thank you!

For more information:

- Stop by our booth during lunch
- http://horticulture.ucdavis.edu
- Subscribe to our newsletter: blog.horticulture.ucdavis.edu
- Twitter: @HortInnovLab
- Facebook.com/HortInnovLab
- YouTube.com/HortCRSP



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No Single Silver Bullet

Suites of technologies for productivity gains in grain legumes

Presentation for the BIFAD Public Meeting, September 12, 2017

Cynthia Donovan
Feed the Future Legume Innovation Lab
Michigan State University

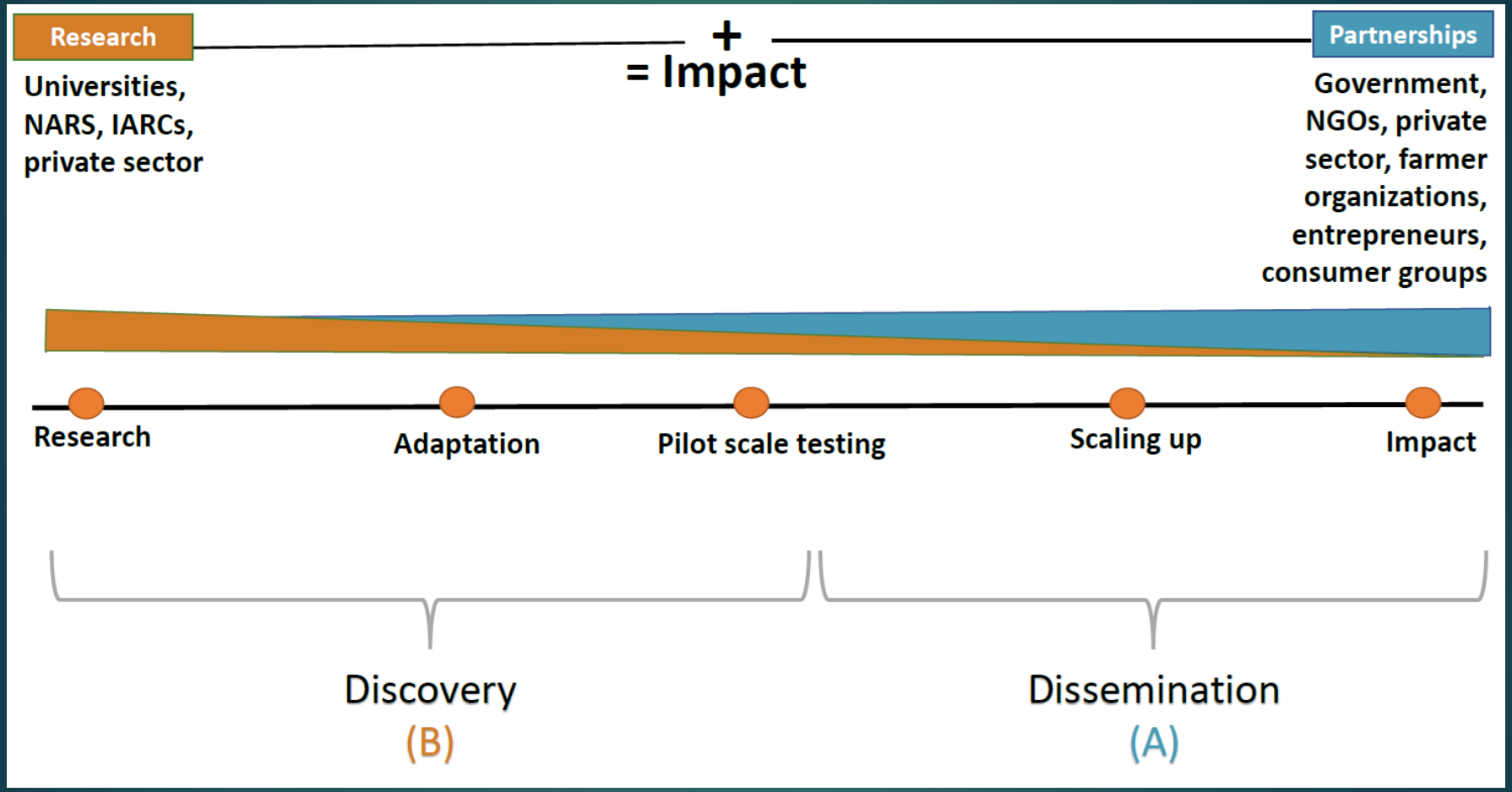
Legume Innovation Lab

USAID
FROM THE AMERICAN PEOPLE

Technologies and impacts

- Masfrijol : Productivity linked to nutrition and training
- Integrated approach to pest management in cowpeas with biocontrols and biopesticides
- PhotosynQ Platform and measurement tools

Research to Impact Pathway



Maredia, 2017

Tech Suite 1: Masfrijol

Agriculture and Nutrition: Integrated programming & joint implementation

* Upstream research to adaptive research and action

* Guatemala Mission funding implementation with collaboration of local partners

Tech Suite 1: Masfrijol

- Years of research: Adapted varieties
- Earlier work in varietal diffusion & seed systems
- Nutritional research in US and elsewhere
- Evaluation of current production and consumption in Western Highlands

Varieties with and w/o BGYMV resistance

Black beans

Partnerships: USAID/BFS, USAID Mission/Guatemala, NGOS (WHIP partners with USAID funding: FANTA, CRS, and others), Guatemalan Ministries of Agriculture and Public Health

Impacts

↑ productivity and ↑ production:
Farmers reported 50% increase in yields

- Improved varieties
- Crop management practices

Photo: C. Wille

Better nutrition:

↑ consumption of beans

+ 1 day a week

22% increase in family quantity consumed

↑ women's dietary diversity

Better understanding of stunting in children

Role of beans in healthy diet for children

Source: Wille 2017

Tech Suite 2: Integrated Pest Management

- Cowpeas: income and food security crop in West Africa (+10 million farmers)
- Pod-sucking insects: damage of 80-100% of yield to cowpeas
- High use of synthetic pesticides (87% in 2016 survey in Benin)
- Farmers attribute acute health impacts to pesticides

Maruca vitrata

Synthetic pesticide

Integrated approach to cowpea pests

Biopesticides pesticides: Neem oil and Virus

Wasp (Therophilus javanus)

- Biologicals: Locally produced
  Women's associations & Private Sector agents
- Biocontrol agents are now established in limited areas.
- Key to this approach: Education and training of farmers

Legume Innovation Lab: Proof of concept of animated videos via cell phone for training

Especially designed for low-literacy learners. High acceptance by Women.

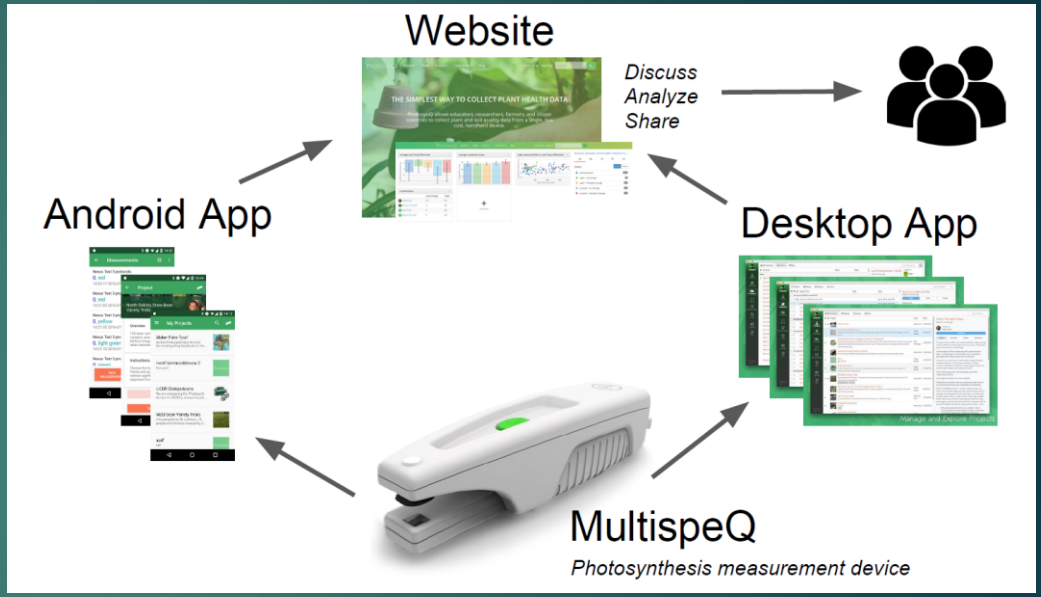
SAWBO
Scientific Animations Without Borders

- Demonstrated effectiveness
- Complementing/ substituting for live extension demos.

Collaborators and users: UN Agencies; US government agencies (eg. CDC); TV stations (Nigeria and elsewhere); NARS; NGOs

Tech Suite 3: PhotosynQ Platform

- Upstream research
- Low cost big data platform
- Easy, adaptable tools for measurements, still evolving (+700 out)
- Make agriculture exciting for young agripreneurs



Collaborators: US Universities (MSU, UCR, NDSU, etc.); US government agencies (DOE, USDA); Latin American,, European,, African & Canadian Universities; Private sector (eg Syngenta); CGIAR (eg. IRRI); Foundations (Bill & Melinda Gates Foundation, McKnight); GCFSI (MSU)

Three technology suites

- Masfrijol : Integrated agriculture/nutrition
- Biocontrols, biopesticides and an integrated approach to pest management in cowpeas
- PhotosynQ Platform and instruments

SAWBO
Scientific Animations Without Borders

Check out www.legumelab.msu.edu **and** https://www.feedthefuture.gov/article/6-things-beans-bring-table

BIFAD Public Meeting
12 September 2017

RESEARCH PROGRAM ON
Policies, Institutions, and Markets
CGIAR
Led by IFPRI

Practical Applications of Policy-Oriented Research

Karen Brooks

Director, CGIAR Research Program on Policies, Institutions, and Markets (PIM)

RESEARCH PROGRAM ON Policies, Institutions, and Markets
CGIAR
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We seek impact through four main channels of influence

Channels 2 and 3 have greatest direct application in specific geographic contexts

Other two are equally important: influencing global debates and contributing to capacity development

Keeping tools and models up to date for rapid deployment, training in their use, contributing to global discourse to shift terms of discussion (our equivalent of basic breeding in the agri-food system programs)

RESEARCH PROGRAM ON Policies, Institutions, and Markets
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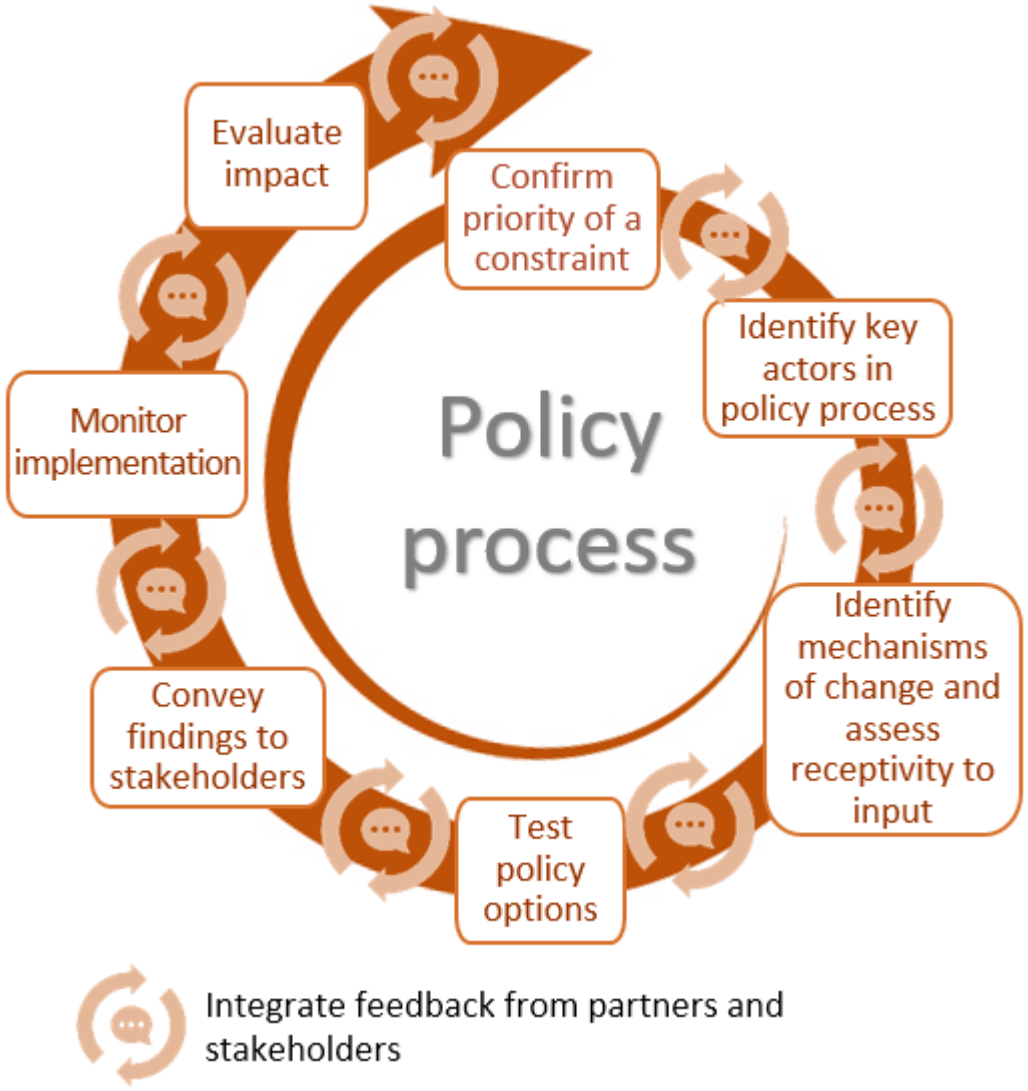
Positioning applied research for impact

Clients

- Public sector/ policy-makers
- Program implementers
- Private firms in partnership with public sector
- Donor organizations

Contribution and relevance. *(We do not claim attribution.)*



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Example: Analytical input to Government of Rwanda's Strategic Plan for Agricultural Transformation 4 for 2018-2022

Key issues to be decided

- Magnitude and composition of investment in agriculture
- Accompanying policy reforms in finance, trade, social protection
- Geographic targeting of range of instruments to address poverty and promote growth

Analytical framework

- CGE model based on updated characterization of the economy in 2015
- Scope for subsectoral growth in agriculture, generation of non-farm jobs

Farmers transporting bananas to market in rural Rwanda
©IFPRI/Gwendolyn Stansbury, Flickr

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Example: Analytical input to Government of Rwanda's Strategic Plan for Agricultural Transformation 4 for 2018-2022 (continued)

Terraced Hillside, Rwanda
Photo: Gwendolyn Stansbury/ IFPRI, Flickr

Key findings

- 25% of farm households with .7 ha or more can diversify; opportunities for high value production and regional exports
- 30% of farm household have less than .2 ha; poor prospects for income diversification. Will need enhanced social protection
- Informal SME's provide income opportunities in food systems and for rural people; should be encouraged rather than penalized

Beneficiary population for Transformation Plan

- National in scope, but especially the 2/3 of population that will still live in rural areas in 2020

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Example: Changing demand for mechanical power in Africa south of the Sahara: Institutional responses

- Growth in farm size, rising demand, increased cost of labor
- Known theoretically for decades, now seen in practice (e.g., Ghana)
- Level and type of demand for services locally specific

Constructive role for public sector

- Stay out of direct provision of machines or services
- Provide regular updates on demand and supply (information)
- Facilitate south-south exchange of experience on models available
- Vocational training in machinery operation and maintenance
- Examine import duties on spare parts
- Fix roads

Photo credit: IFPRI , Flickr

Policy discussion still under way. Need to monitor to assess impact and number of beneficiaries

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Example: Program design. Ethiopia PSNP

Covers about **8 million people;** about **$3.5 billion dollars** committed in a new fourth phase.

IFPRI and local partners have done impact assessments every 2 years since 2006.

Evaluation results improved general targeting of the program and directly influenced:

i) Setting the levels of transfers levels and wage rates for public works;

ii) Criteria for graduation from the PSNP;

iii) Timeliness of payments to beneficiaries.

Recent findings on nutrition:

– participating households benefit, but indicators of child nutrition (specifically child stunting) not improved

- transfer combined with simple messages on child feeding practices make a difference

- corresponding changes in program design

Image: Tanya Axisa/Department for International Development. Flickr

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Example: Picture-based insurance in India

Farmers reluctant to buy weather index-based insurance (PBI) due to low correlation between actual loss and payoff


Francisco Ceballos/IFPRI

A few take-aways from the PBI evaluation*:

- Farmers are able and willing to take pictures.
- Damage is visible from smartphone pictures and can be quantified by agronomic experts.
- Picture-based loss assessments correlate better than index-based assessment with actual losses.
- Farmers are willing to pay more for picture-based insurance (PBI) than for weather index-based insurance (WBI).
- No evidence of picture-based crop insurance inducing moral hazard or adverse selection.
- Combining insurance with advisory services, education about risk and insurance, and credit may offer further gains.
- Blended products, with pictures for some risks and index for others may be useful in some places.

Beneficiary base and potential for scaling not yet determined. Private sector will be instrumental.

*A formative evaluation was conducted in the Rabi (winter) season during 2016 and 2017 in six districts of Haryana and Punjab, India.

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Conclusions about practical applications of policy-oriented research

Many examples.

We are proud of them.

We do not focus exclusively on localized applications.

- We are a global scientific organization with a split mandate
  - Global public goods
  - Applied scientific research

We are scientists in development space.

Photo by Khant Zaw, Bioversity International, Flickr

We create tools for the profession, and cannot always monitor their use.

- Our country-level SAMS
- IMPACT and MIRAGE models
- ASTI data

We dig some dry wells.

Good advice is often rejected.

Development outcomes are improved when analytical capacity to evaluate policy is embedded in program design.

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Applying Research to Emerging Threats

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Dr. Pamela Anderson

Drought- and Heat-tolerant Maize in the Tropics, and Tackling the Fall Armyworm Crisis in Africa

Dr B.M. Prasanna

Director, Global Maize Program, CIMMYT &

CGIAR Research Program MAIZE;

Email: b.m.prasanna@cgiar.org

Maize provides food and income to several million people in the developing world

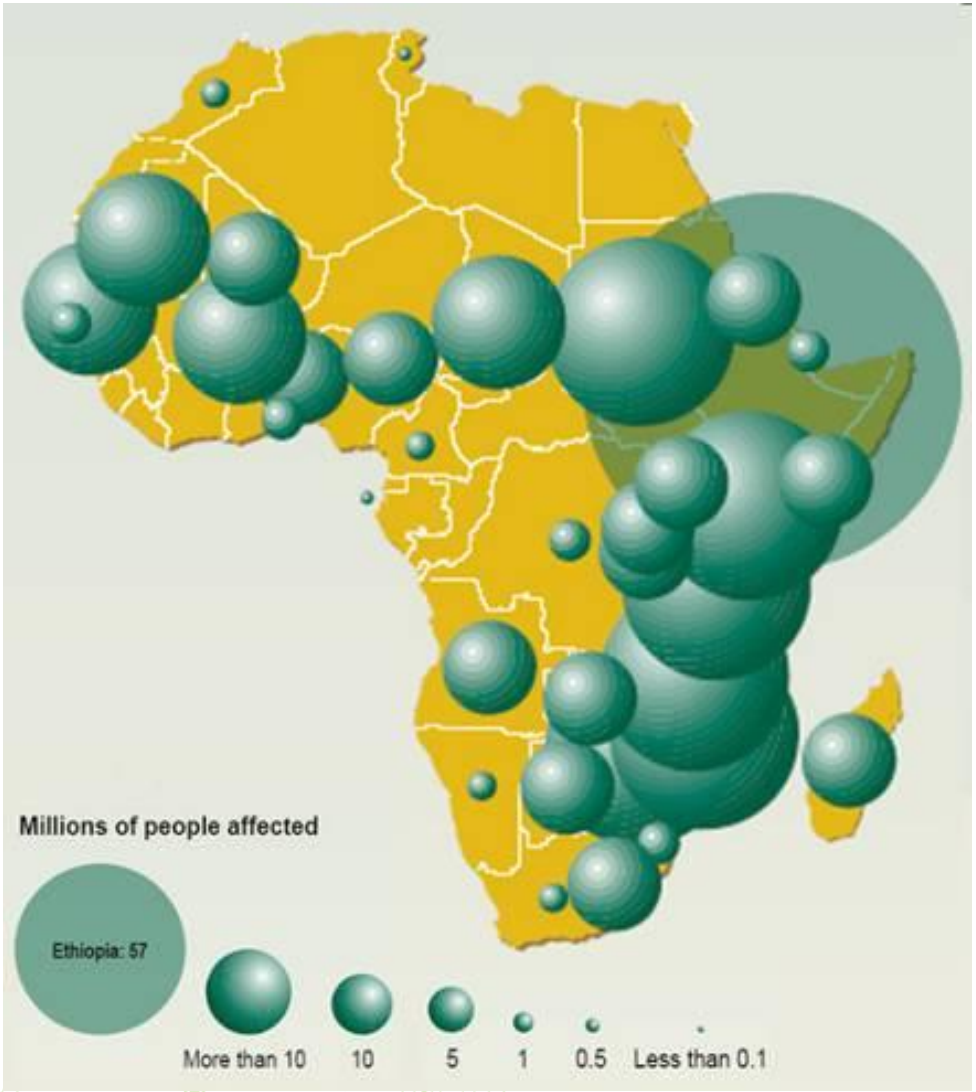
Cropping systems and smallholder farmers in SSA, LatAm and Asia depend heavily on maize due to its multi-faceted uses (food, feed, fodder).

- **>300 million metric tons** of maize produced on **90 million hectares** across the developing world (SSA, Latin America, Asia).
- **36 M ha of maize in SSA, feeding >200 million poor people.**
- Of the **22 countries with highest per capita consumption of maize**, 16 countries are in SSA.

RESEARCH PROGRAM ON Maize
CGIAR

The Impact of Drought in the Tropics

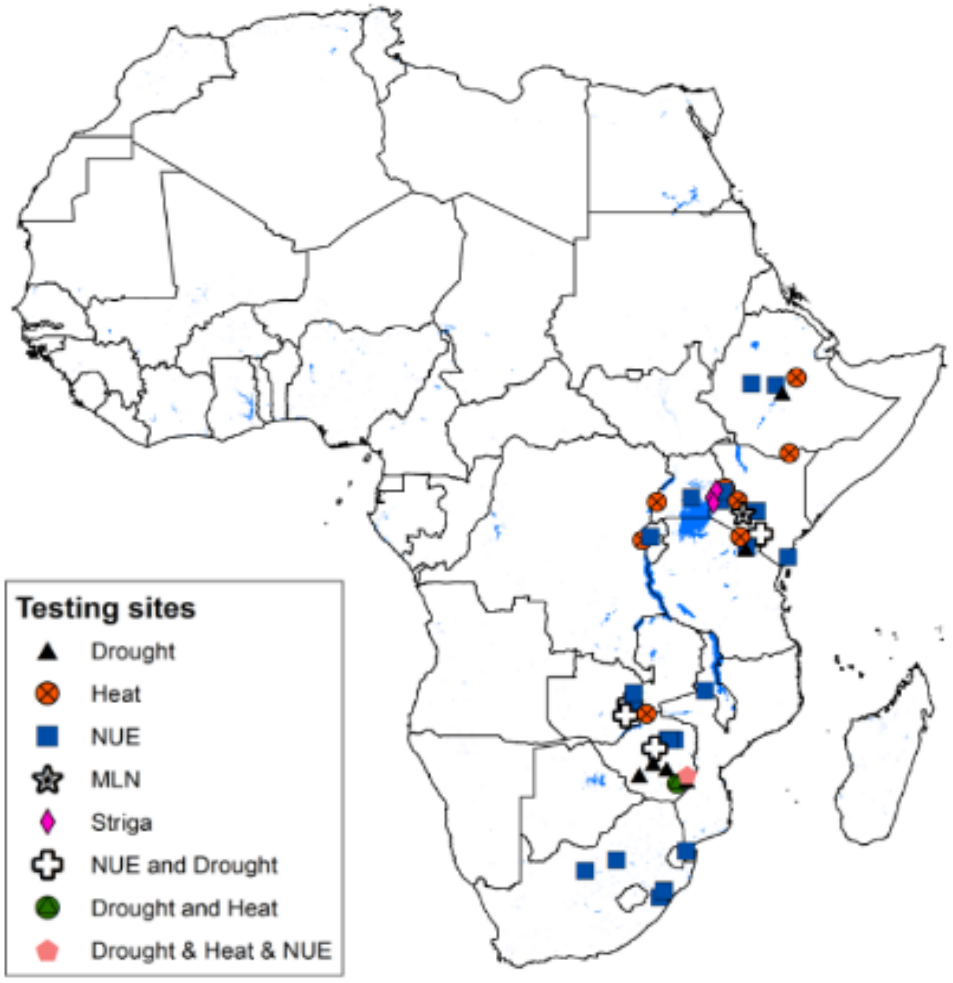
- **Drought** is an unfortunate recurring theme in **sub-Saharan Africa.**
- **El Niño in Southern Africa, 2015-2016** affected food security of an estimated **15.9 million people.**



CIMMYT

Breeding for drought tolerance at CIMMYT is four decades old…

An extensive phenotyping network with a strong product pipeline…



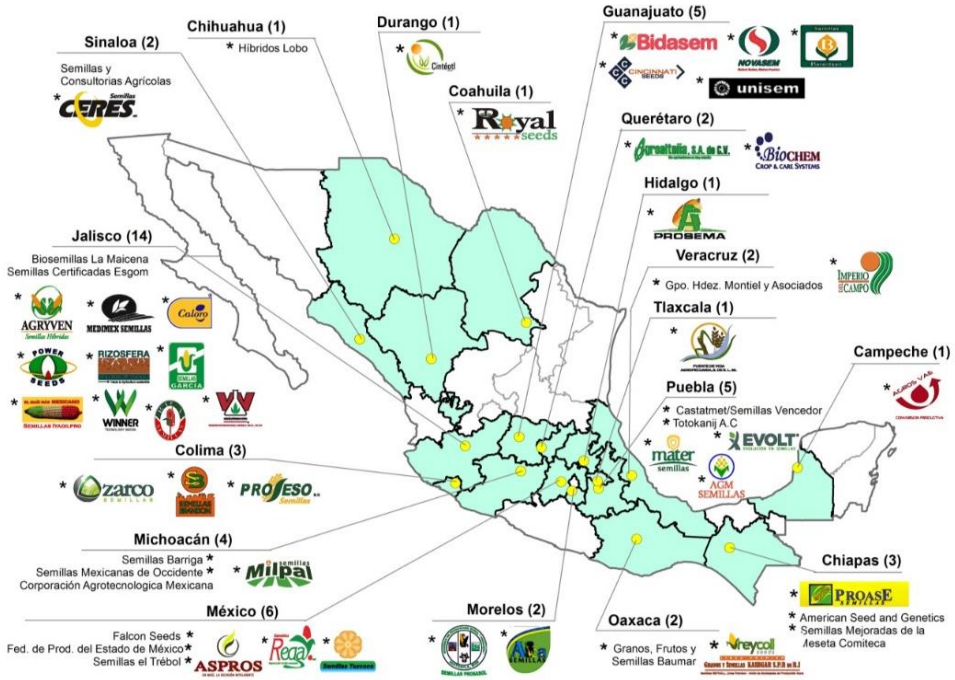
More than **230** elite drought tolerant and disease resistant maize varieties released through public and private sector partners across Africa in the last 10 years (70% hybrids), based on CIMMYT maize germplasm.

Managed stress phenotyping network across sub-Saharan Africa

CIMMYT

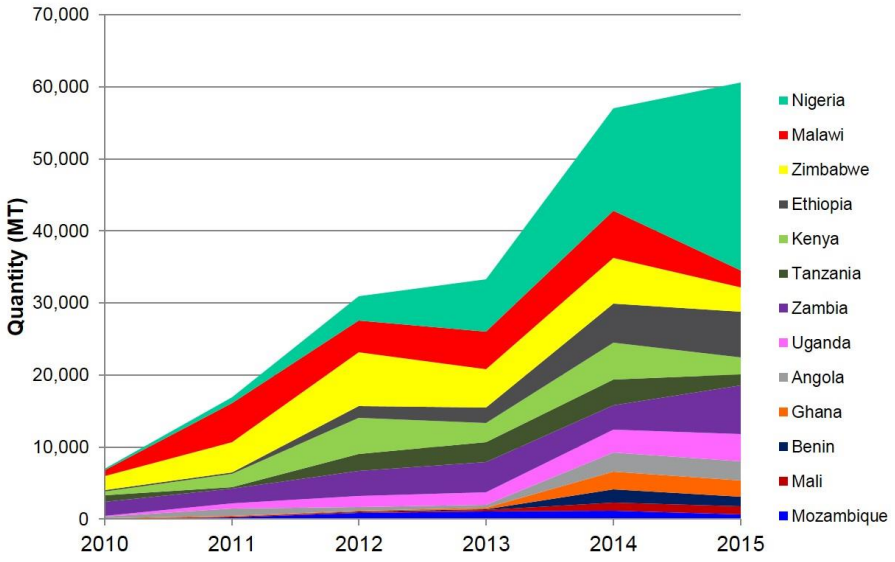
Partnership with >200 local, regional and large seed companies in Africa, Asia, and Latin America

- Diverse products for diverse ecologies and markets
- Diverse partners with diverse capacities and germplasm needs (and trait combinations)



Drought Tolerant Maize in Africa: A Success Story

Country	Certified Seed marketed (Tons)	Beneficiaries	
		'000 HH	'000 people
Nigeria	26,137	2,614	28,750
Zambia	6,677	668	4,273
Ethiopia	6,256	626	4,755
Uganda	3,845	385	2,384
Zimbabwe	3,397	340	1,597
Angola	2,626	263	1,744
Kenya	2,386	239	1,599
Malawi	2,350	235	1,222
Ghana	2,299	230	2,529
Tanzania	1,587	159	1,159
Benin	1,302	130	1,693
Mali	1,150	115	1,035
Mozambique	603	60	374
Total	**60,615**	**6,061**	**53,112**



- Estimated present economic value of increased maize production due to DT maize in 2016:

  US$ 162 M each year

- Potential economic value by 2022:

  US$ 328 M each year

CIMMYT

A new Drought + Heat Tolerant CIMMYT Maize Hybrid compared to a commercial check

How did CIMMYT-derived maize hybrids perform during the El Nino-induced drought and heat in southern Africa (2015-16)?

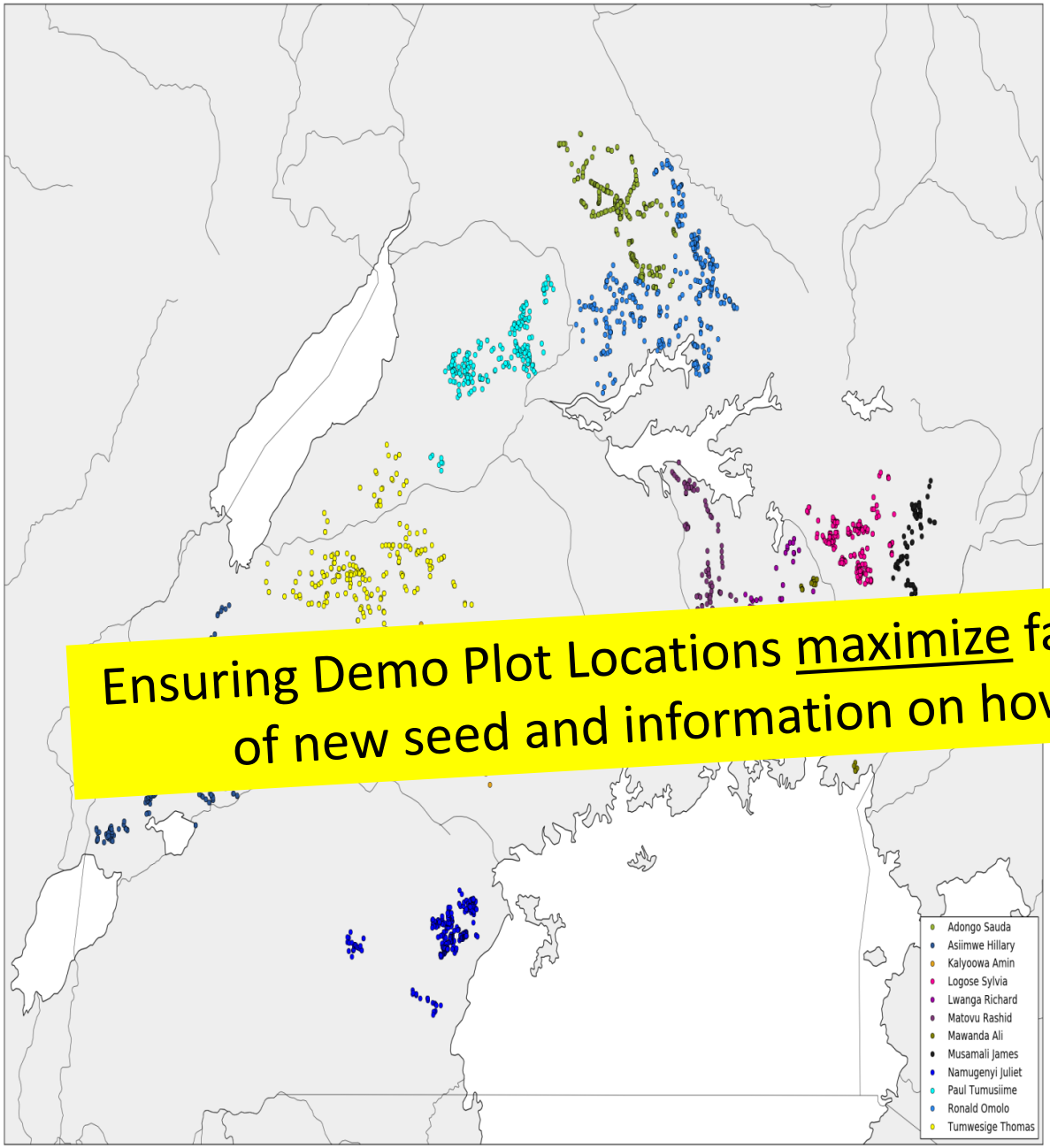
CIMMYT-derived varieties **yielded almost double** than the most popular commercial variety (SC513)

1.5 Mg ha^{-1} compared to 2.9 Mg ha^{-1}

Source: Setimela et al. 2017

CIMMYT

Mapping Demo Plots to Farmer Locations

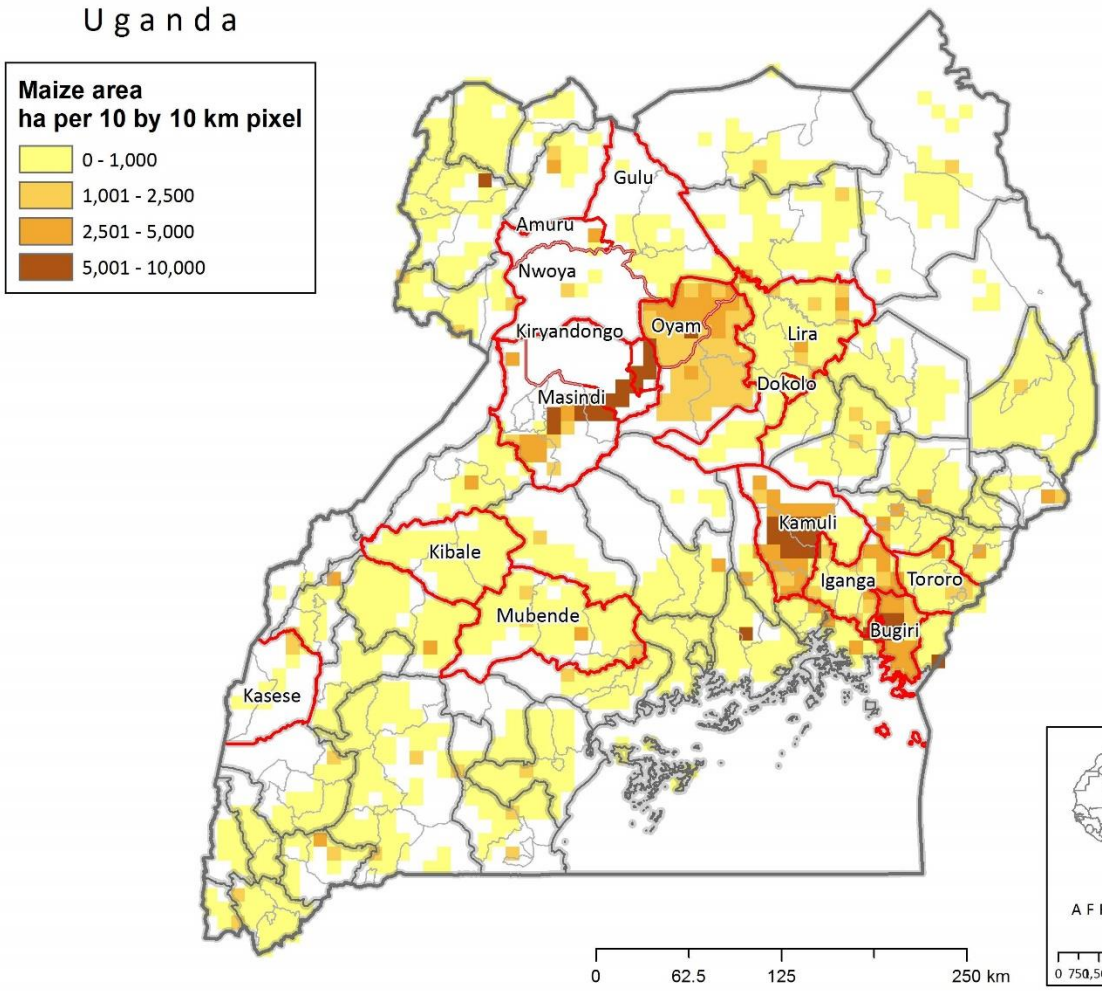


Ensuring Demo Plot Locations maximize farmer awareness of new seed and information on how to grow it

NASECO Maize Demo Plots in Uganda - 2016

Go-to-Market Strategy for DT + MLN-tolerant Varieties

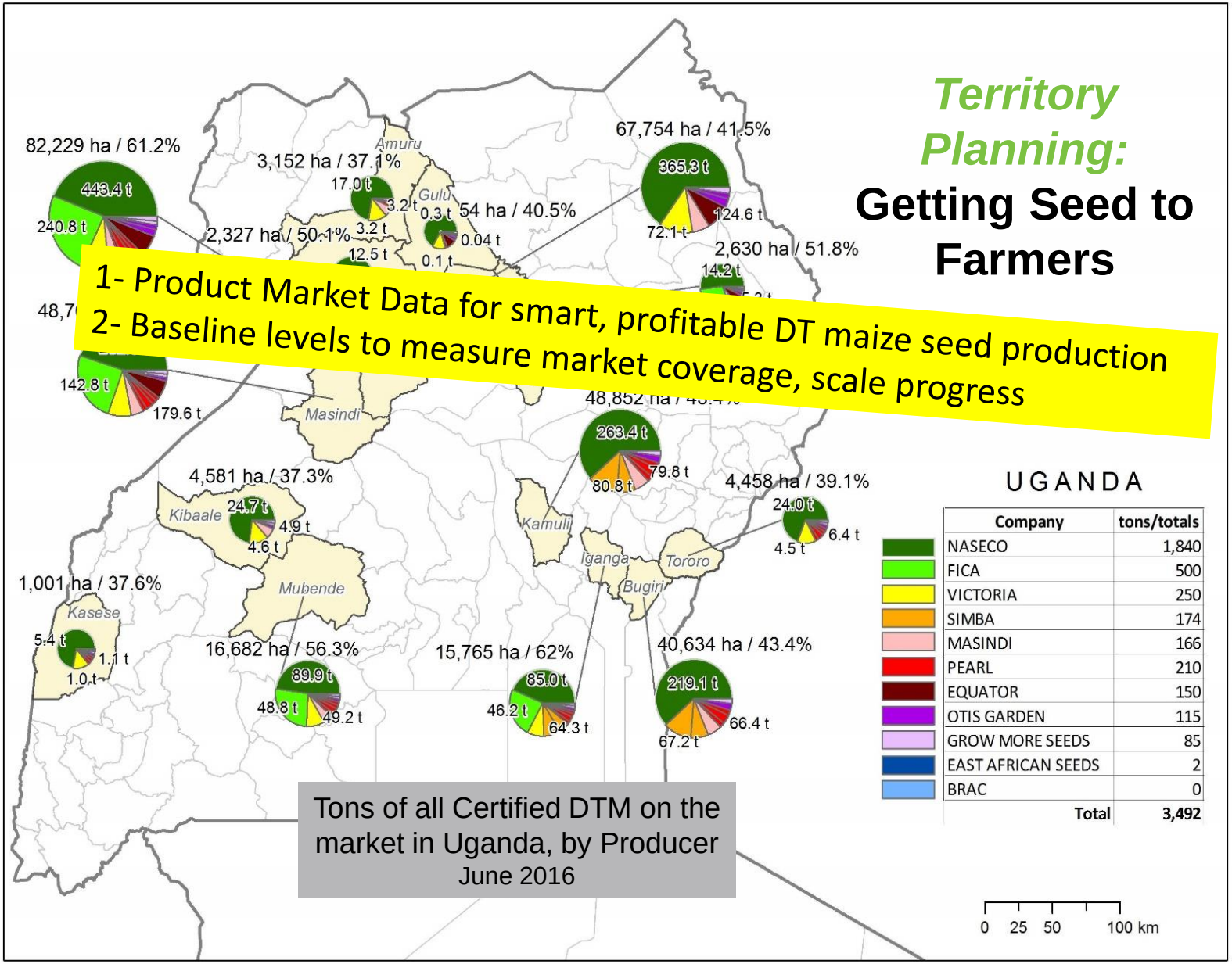
Uganda



District	Area ha
Oyam	63,166
Kiryandongo	55,744
Masindi	48,768
Apac	44,596
Kamuli	43,678
Bugiri	35,252
Namutumba	23,400
Buyende	21,437
Kole	19,390
Mubende	16,682
Iganga	15,765
Jinja	11,309
Kayunga	10,963
Namayingo	10,634
	420,783

Territory Planning:
Getting Seed to Farmers

1- Product Market Data for smart, profitable DT maize seed production
2- Baseline levels to measure market coverage, scale progress



Company	tons/totals
NASECO	1,840
FICA	500
VICTORIA	250
SIMBA	174
MASINDI	166
PEARL	210
EQUATOR	150
OTIS GARDEN	115
GROW MORE SEEDS	85
EAST AFRICAN SEEDS	2
BRAC	0
Total	**3,492**

Tons of all Certified DTM on the market in Uganda, by Producer
June 2016

Targeted Varietal Replacement

Some examples

Old variety	Year of release	New variety	Year of release
BH660 (ET)	1993	BH661	2011
Melkassa2 (ET)	2004	BH547	2013
Katumani (ET)	1974	MH130; MH138Q	2012
Staha (TZ)	1983	HB405	2012
Situka1 (TZ)	2001	TZM523	2012
Longe 4 (UG)	2000	Bazooka	2013
SC513 (Zm)	1999	KAM601	2008
SC513 (Zw)	1999	PAN53	2007
SC513 (Mw)	1999	Peacock10	2014
PHB30G97	2000	KKS501; KKS603	2014

BH661, a DT maize hybrid in high demand by farmers in Ethiopia

Year	Seed produced (t)	
	BH660	BH661
Released in	1993	2011
2012	5,778	6
2013	5,243	497
2014	2,509	2,903
2015	1,369	5,588
2016	1,478	8,767

CIMMYT

Effectively reaching the women farmers with improved agricultural technologies is key..

African farmer is primarily a woman farmer – involved in all aspects of agriculture, from crop selection to land preparation, to seed selection, planting, weeding, pest control, harvesting, crop storage, handling, marketing and processing.

- Seasonal male migration has led to feminization of agriculture in **Nepal**.
- Agriculture sector employs four-fifth of all economically active women in **India**.

CIMMYT

Gender in Maize Seed Value Chain

Strengthening capacities of women farmers

- Awareness about Improved Seed and Agronomy
- On-farm Demos & Field Days
- Access to Finance
- Extension / Advisory services
- Training Programs
- Gender training of agro-dealers and seed companies

CIMMYT

DT Maize Adoption and Impacts in Africa

Climate Change (2015) 133:283-299.

Drought tolerant maize for farmer adaptation to drought in sub-Saharan Africa: Determinants of adoption in eastern and southern Africa

Monica Fisher[1] · Tsedeke Abate[2] · Rodney W. Lunduka[3] · Woinishet Asnake[4] · Yoseph Alemayehu[4] · Ruth B. Madulu[5]

Agriculture and Food Security (2017) 6:30.

RESEARCH Open Access

Characteristics of maize cultivars in Africa: How modern are they and how many do smallholder farmers grow?

Tsedeke Abate[1*], Monica Fisher[2,3], Tahirou Abdoulaye[4], Girma T. Kassie[5], Rodney Lunduka[6], Paswel Marenya[2] and Woinishet Asnake[2]

Food Security (2014) 6:217-230.

Evaluating the impact of improved maize varieties on food security in Rural Tanzania: Evidence from a continuous treatment approach

Menale Kassie · Moti Jaleta · Alessandra Mattei

Agricultural Economics (2015) 46:1-12.

Ex post impacts of improved maize varieties on poverty in rural Ethiopia

Di Zeng[a,*], Jeffrey Alwang[a], George W. Norton[a], Bekele Shiferaw[b], Moti Jaleta[c], Chilot Yirga[d]

[a]*Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA 24061, USA*
[b]*Partnership for Economic Policy, P.O. Box 30772-00100, Nairobi 00621, Kenya*
[c]*International Maize and Wheat Improvement Center, P.O. Box 5689, Addis Ababa, Ethiopia*
[d]*Ethiopian Institute of Agricultural Research, P.O. Box 2003, Addis Ababa, Ethiopia*

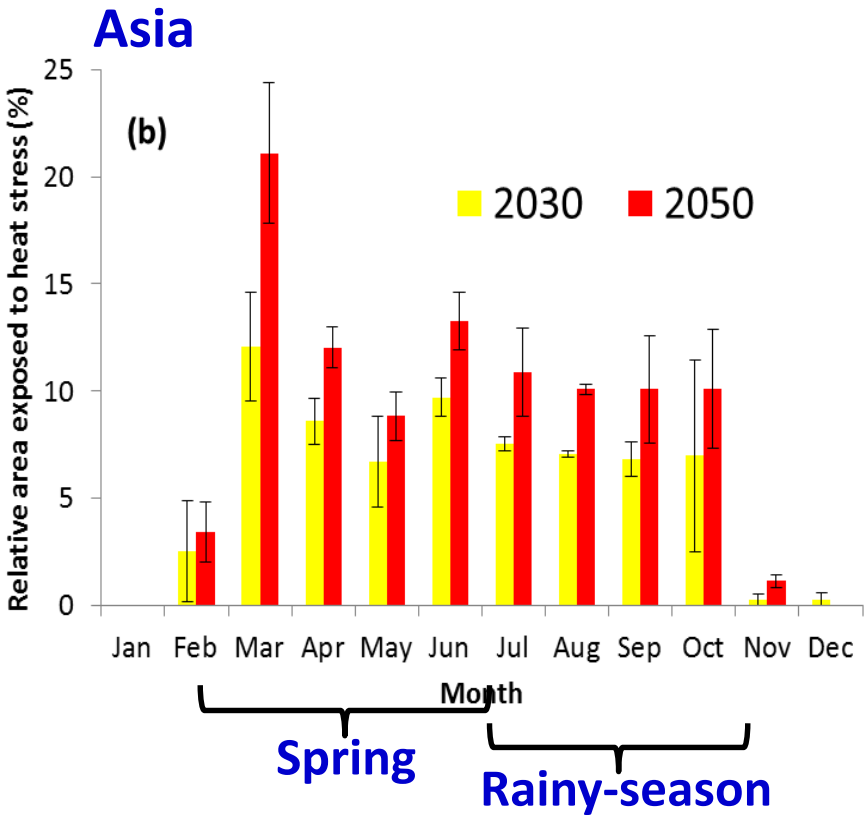
Climate and Development (2017) https://doi.org/10.1080/17565529.2017.1372269.

Impact of adoption of drought-tolerant maize varieties on total maize production in south Eastern Zimbabwe

Rodney Witman Lunduka, Kumbirai Ivyne Mateva, Cosmos Magorokosho & Pepukai Manjeru

CIMMYT

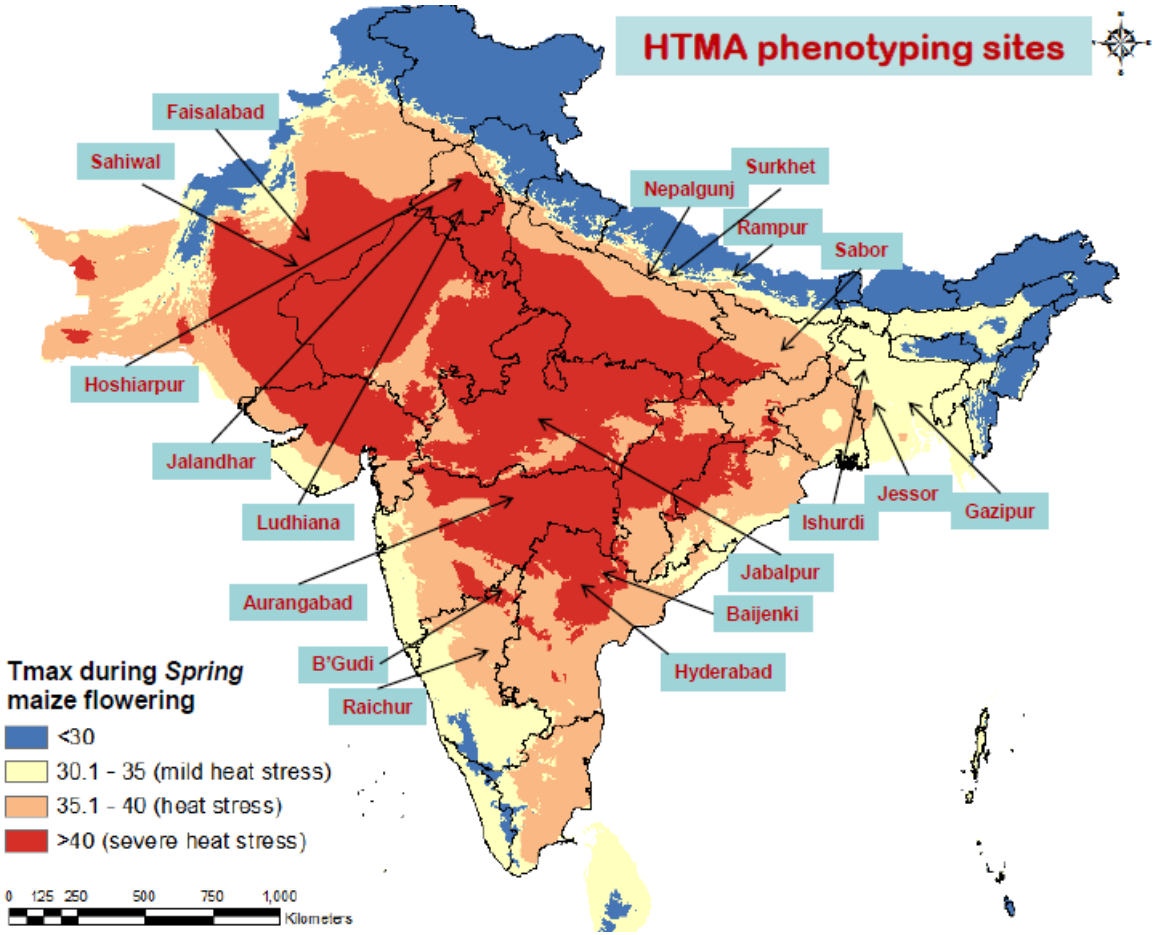
Heat stress tolerance in maize is becoming increasingly important in the tropics…



Potential impact on at least **11-15 M ha of maize in South and South-east Asia by 2030**

CIMMYT

Heat Stress Tolerant Maize for Asia (HTMA)



HTMA Partners

- CIMMYT, India
- Purdue University, USA
- BARI, Bangladesh
- UAS, Raichur, India
- BAU, Sabor, India
- NMRP, Nepal
- MMRI, Pakistan
- Pioneer Hi-bred, India
- Kaveri Seed Co. Ltd., India
- Ajeet Seeds Ltd., India

Rapidly expanding public-private partnership → from **3 seed companies in 2012** to **14 seed companies in 2017** to **23 seed companies in 2018 (HTMA-II)**!!

CIMMYT

PHENOTYPING FOR ABIOTIC STRESS TOLERANCE IN MAIZE:

HEAT STRESS

P.H. Zaidi, M. Zaman-Allah, S. Trachsel, K. Seetharam, J.E. Cairns and M.T. Vinayan

CIMMYT.

At High (>40^{0}C) Temp. + High (>5kPa) VPD

35 heat tolerant maize hybrids licensed to partners in Bangladesh, India, Nepal, and Pakistan in 2015-2016.

Heat tolerant maize hybrids licenced in South Asia

Country	Partners	Type	2015	2016
Bangladesh	**BARI**	NARS	4	
	ACI Ltd	SME	2	4
	Supreme	SME		2
	Krishibid	SME		1
Pakistan	**Zamindara Seeds**	SME	3	
	Jullundar Seeds	SME	2	1
	Hisell Seeds	SME	4	3
	MMRI	NARS		3
Nepal	**NMRP**	NARS	5	2
	SEAN Seeds	SME		1
India	**Ajeet Seeds**	SME	2	3
	UAS-Raichur	NARS	2	4
	BAU, Sabor	NARS		2
	Kaveri Seeds	SME		1

6 heat-tolerant maize hybrids released so far – two each in Bangladesh, Nepal and India

CIMMYT

Besides product development and PPPs, what makes HTMA so unique?

- First extensive description of the **maize leaf transcriptome and lipidome remodulation** in response to heat stress on maize.
- **Genomic regions for heat tolerance in maize identified and validated** → potentially used in marker-assisted breeding.
- **Rapid cycle genomic selection (RC-GS)**, with a series of DH lines generated from the improved populations.

How does this work benefit US Corn Belt?

Purdue University (Prof. Mitch Tuinstra's team):

- **Temperate-tropical introgressions** for improving drought and heat tolerance
- **Genomic predictions**, and **crop modelling**
- **Systems biology**
- **A strong platform for training US post-graduate students** on breeding for stress resilience in maize

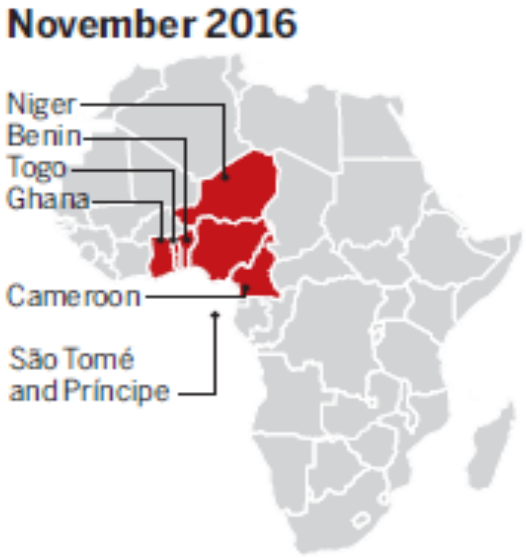
CIMMYT

Fall Armyworm (*Spodoptera frugiperda)*

A new and major threat in Africa

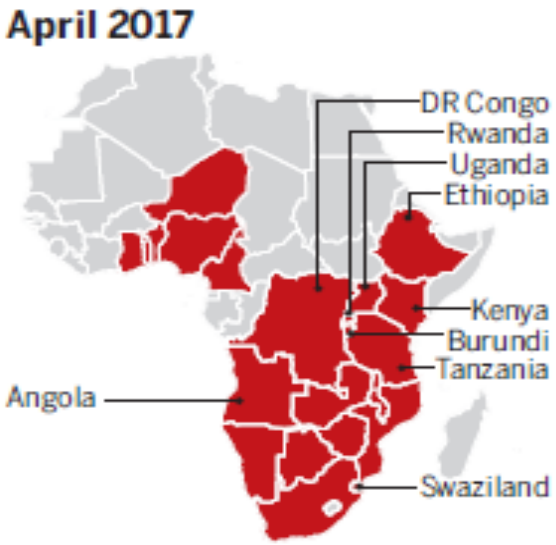
CIMMYT

Rapid Spread of Fall Armyworm in Africa



May 2017

FAO



Science, 5th May, 2017

CIMMYT

Damage to the maize crop is the most visible

- Moderate to severe attack on maize crops reported on **more than 500,000 hectares in Africa so far**, with most of the damage in southern Africa.
- Across sub-Saharan Africa, the estimates (by CABI) indicate **13.5 million tonnes of maize** valued at **US$ 3 billion** are at risk from FAW in 2017-2018; this forms over 20% of total production for the region.

An Action Plan formulated based on inputs from nearly 160 participants from diverse organizations worldwide

An IPM strategy based on successes and lessons learnt in the US and Brazil, and tailored to African agro-ecologies…

- Effective Scouting
- Monitoring and Surveillance
- Low-cost, effective and relatively safer synthetic pesticides (USAID-PERSUAP)
- Biological control
- Host plant resistance (conventionally-derived, and transgenic)
- Cropping system management
- Strengthening local and regional capacities

Creating massive awareness among farming communities

Thanks!

- **Partners in Africa, Asia, Latin America** and in **ARIs worldwide** for tremendous support
- **Funding agencies,** especially USAID, Bill & Melinda Gates Foundation, DFID, GIZ/BMZ, SFSA, and MAIZE CRP.
- **CIMMYT and IITA colleagues** for their commitment to the mission

Profile of a Cereal Killer, *Magnaporthe oryzae* (synonym *Pyricularia oryzae*)

Ancient disease: rice blast

Rice pathotype

Emerging disease: wheat blast

Wheat pathotype

Barbara Valent
Dept. of Plant Pathology, Kansas State University
PD, USDA-NIFA Blast Integrated Project

KANSAS STATE UNIVERSITY

NIFA Blast Integrated Project

United States Department of Agriculture
National Institute of Food and Agriculture

Wheat Blast Research in the U.S.

2009 - 2012

AFRI Competitive Grant 2009-55605-05201 from USDA-NIFA

Brazil | Bolivia | Paraguay

2013 - 2017

Blast Integrated Project (BIP): AFRI Competitive Grant 2013-68004-20378 from the USDA-NIFA

Blast Integrated Project

Two Potential Routes to Wheat Blast in the U.S.

Wheat pathotype

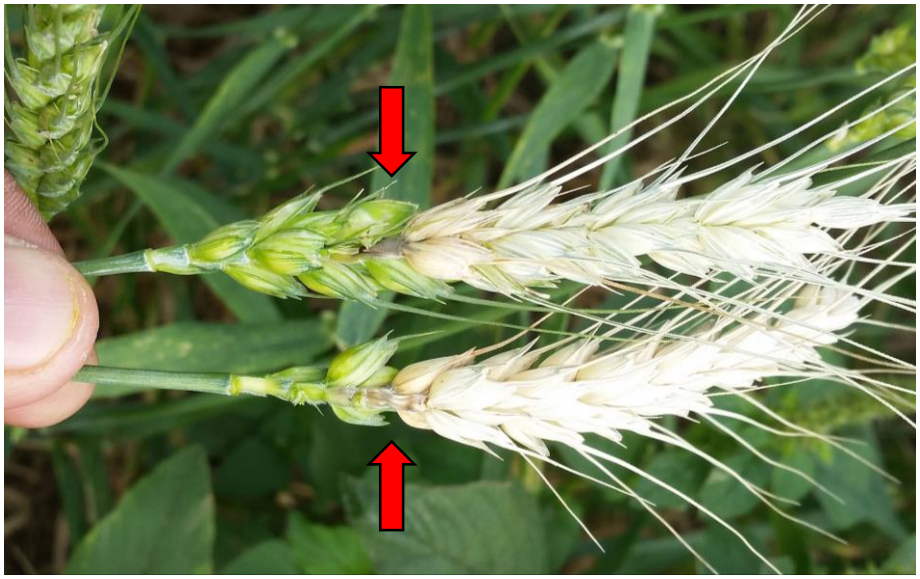
1. Movement of wheat strains from South America (infected seed/grain)

Turf grass pathotype

2. Mutation of turf grass strains to become better wheat pathogens

Scary features of wheat blast disease

- **Hard to control:**
  - **One spore** can kill the entire wheat head.
  - **Favorable environment** can overwhelm resistance plus fungicides.



- **Global grain trade:**
  - **Potential impact is HUGE!**
  - **Seed borne fungus;** can be found in normal-appearing seed.
  - **Movement in grain shipments is stealthy.**

Wheat Blast has a huge capacity to surprise us

Warm rainy weather at heading can result in 100% blasted heads in fields that had appeared healthy.

near Londrina, Paraná
August 2009

Slide from Andreas von Tiedemann & Etienne Duveiller

First report in February 2016: Wheat blast affected ~15% of total wheat area in Bangladesh

Photo by Paritosh Malaker, Bangladesh Agricultural Research Institute

Wheat Blast Incidence in South Asia (2015-16 and 2016-17)

2015-16: First report of Wheat Blast occurrence in Bangladesh in 8 districts. Losses: 25-30%.

2016-17: Disease spread to 6 more districts. Losses: 5-10%; Blast-like symptoms observed in India.

RAPID RESPONSE: BIP members worked with CIMMYT and BARI scientists and used genomics to identify the fungus in Bangladesh as most similar to highly aggressive Wheat Blast strains from South America.

Modified from slide by Pawan Singh, CIMMYT

Wheat Blast Resistance Screening

In the U.S., only two BSL-3 labs approved to work with the *Triticum* pathotype - Kansas State University and USDA-ARS FDWSRU in Fort Detrick, Maryland

Field tests in Bolivia: identified collaborators and established phenotyping platform for two rounds of testing per year

Kansas State University

USDA ARS

Kansas State University

Triapo
Asociacion de Productores de Oleaginosas y Trigo

CIAT
Centro de Investigación Agrícola Tropical

NIFA Blast Integrated Project

Selected BIP accomplishments:

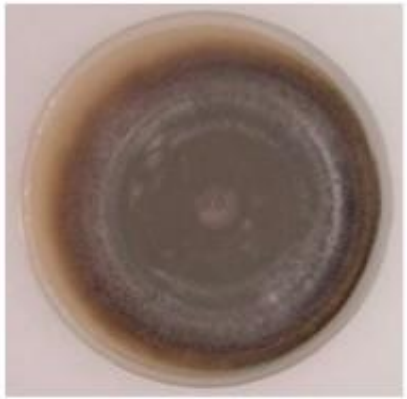
- **On wheat blast resistance**
  - **Shown most commercial varieties are susceptible**
  - **Discovered resistance in the *Ae. ventricosa* 2NS-translocation fragment that gives partial control**

CRITICAL: Screen wheat SEED BANKs for resistance

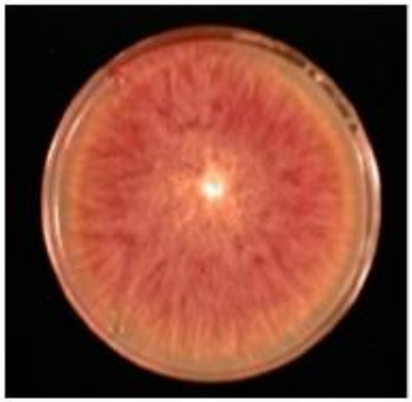
- **On disease epidemiology and management**
  - **Shown that fungus in seed and first seedling leaves provides inoculum for head blast *(Led to recommendations for seed and foliar fungicide treatments)***
  - **Shown that wheat (MoT) and ryegrass (MoL) pathogens infect a broad range of alternative hosts *(rye, triticale, barley, oats, various weeds)***

Training and Disease Surveillance Critical

***Magnaporthe* Wheat Blast**



***Fusarium* Head Scab**



Selected BIP accomplishments:

- **Extension literature & training (Who should look?)**
- **Climate suitability studies (Where do we look?)**
- **Disease forecasting (When do we look?)**
- **Diagnostics being incorporated into the National Plant Disease Network (How do we know it is blast?)**
- **Response and Recovery**
  - **Plant wheat with 2NS-resistance**
  - **Recommended fungicide treatments**

What do we still need to do?

- **Work together to understand the disease better, and find lots more resistance**

What if wheat blast comes to the U.S.?

Let's look at what happened in other countries:

- **Brazil has given up on growing wheat in the Cerrado region**
- **Some areas taken out of wheat production in Bolivia**
- **Wheat production in Bangladesh dropped from 62,763 ha in 2016 to 14,238 ha in 2017 (blast still spread)**

U.S. climate suitability mapping based on weather 5-15 years ago:

- **Soft red winter wheat, especially in the south-eastern U.S. is at risk (used for cookies, cakes and crackers)**
- **Over half of the hard red winter wheat is at risk; 'No risk' zone runs through Northwest corner of Kansas based on these past weather patterns**
- **More accurate models needed, taking into account climate change**

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Blast Integrated Project: supported by Agriculture and Food Research Initiative Competitive Grant nos. 2009-55605-05201 and 2013-68004-20378 from the USDA National Institute of Food and Agriculture.

Blast Integrated Project: Novel Strategies for Managing Blast Diseases on Rice and Wheat

United States Department of Agriculture
National Institute of Food and Agriculture

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Dale Bumpers National Rice Research Institute
Yulin Jia

University of Arkansas
Yeshi Wamishe
Lanier Nalley

Purdue University
Jin-Rong Xu

North Carolina State University
Ralph Dean

****

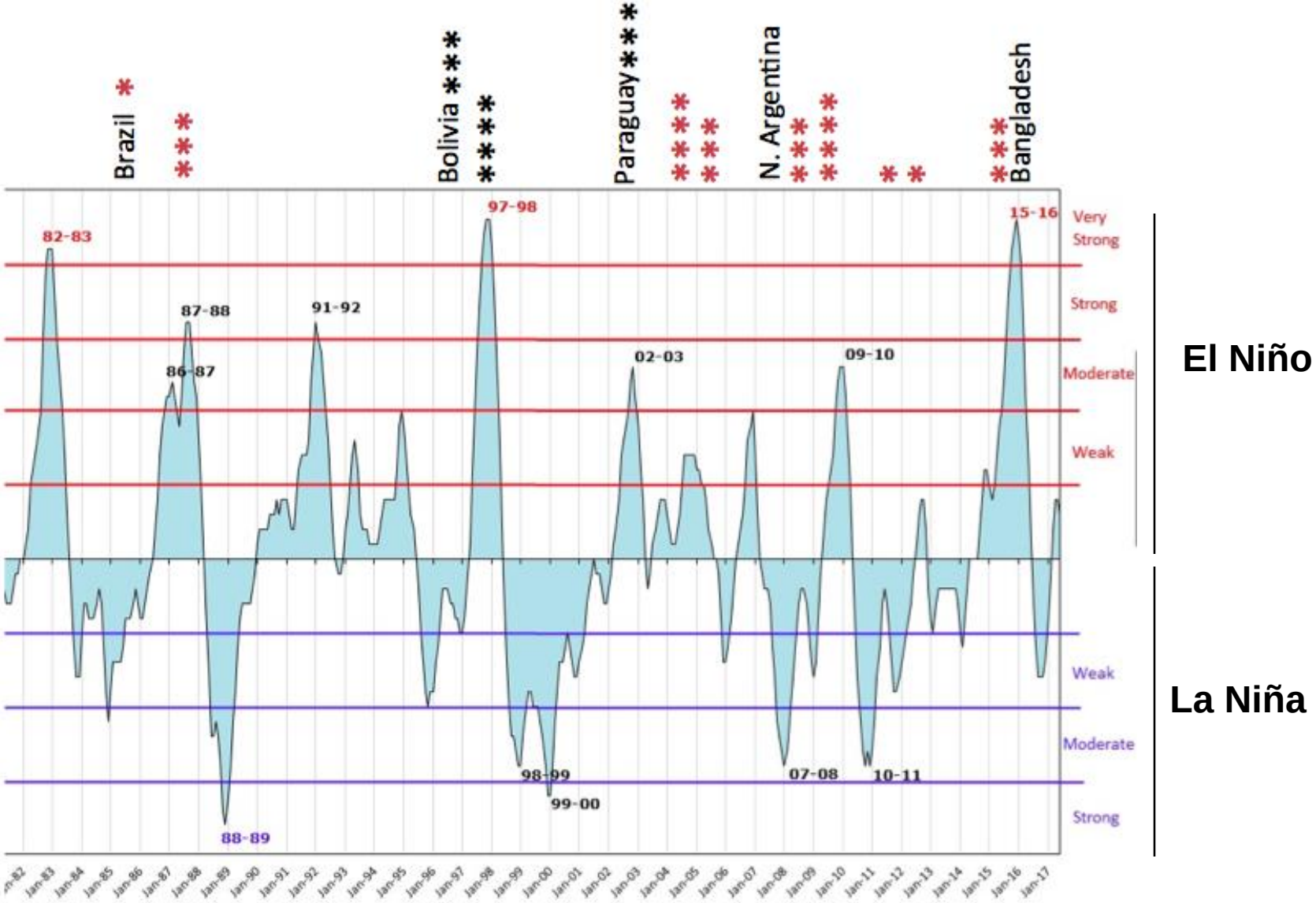
EMBRAPA Wheat, Brazil
José Mauricio Fernandes
João L. Nunes Maciel

ANAPO, Bolivia
Diego Baldelomar

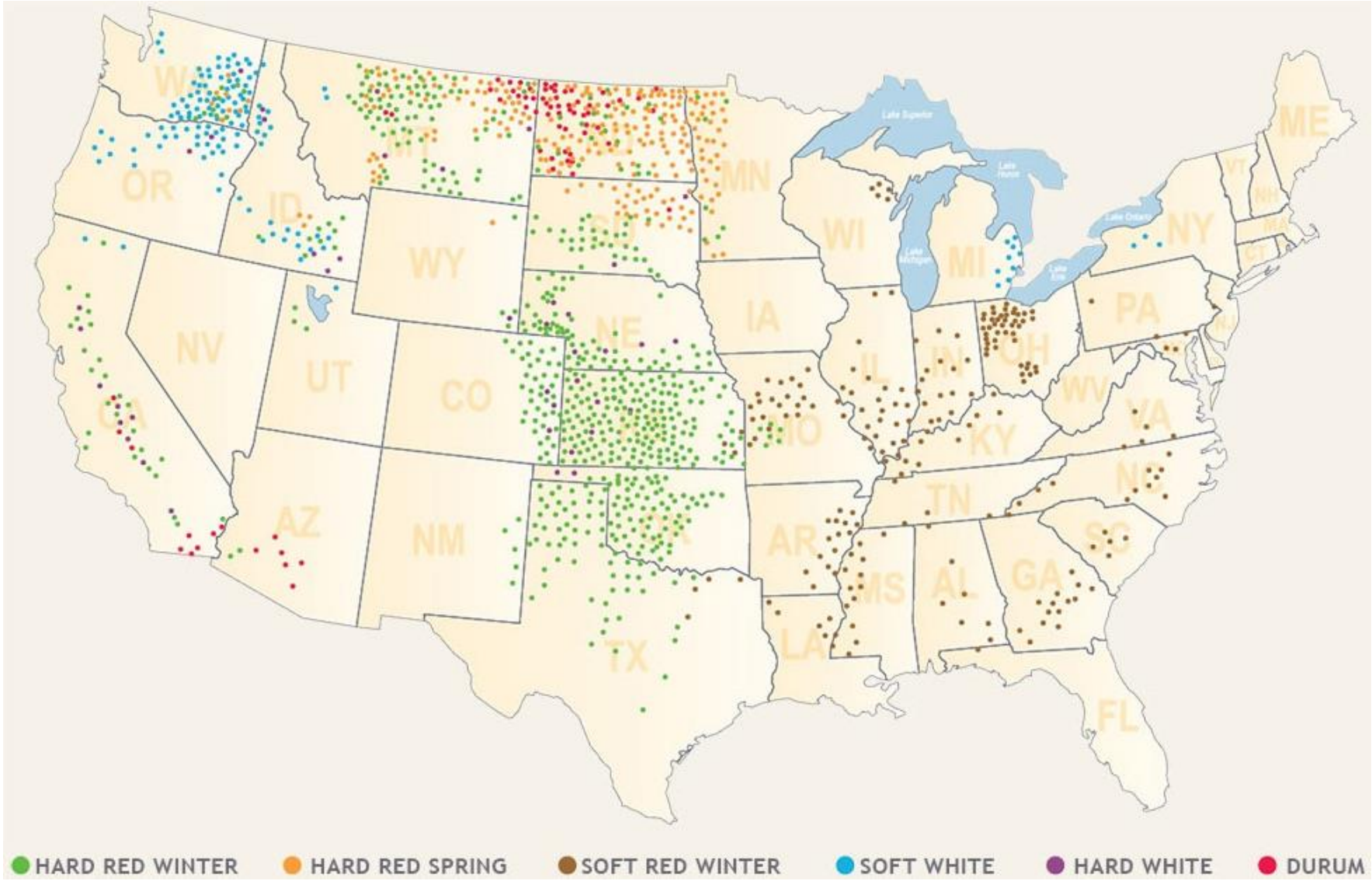
CAPECO/INBIO, Paraguay
Man Mohan Kohli

NIFA Blast Integrated Project

Wheat blast outbreaks and spread are correlated with the El Niño weather pattern



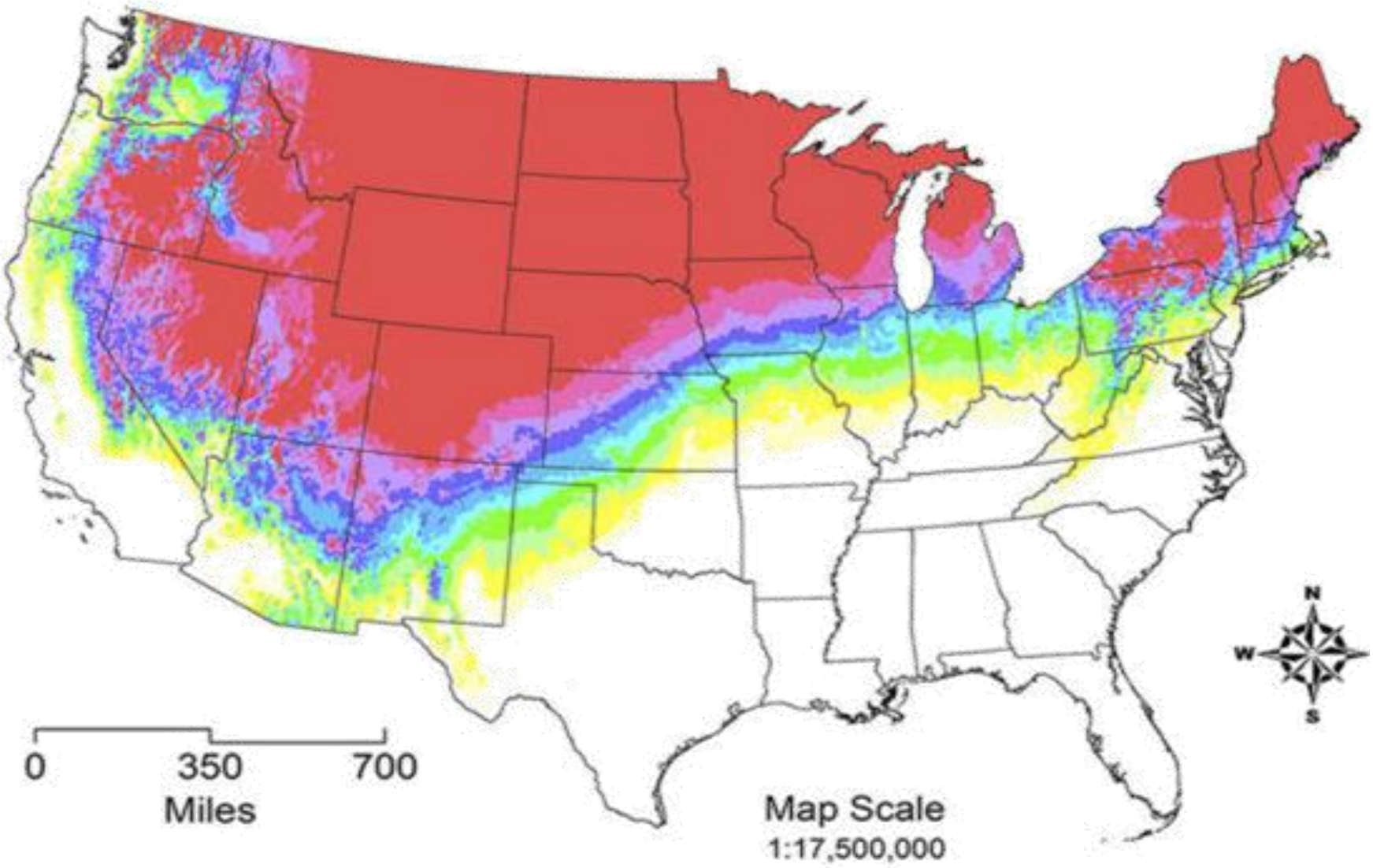
Classes of Wheat and Where Grown in the U.S.



http://www.uswheat.org/wheatClasses

NIFA Blast Integrated Project

Probability of 105 Days of Freezing Temperatures



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NIFA Blast Integrated Project

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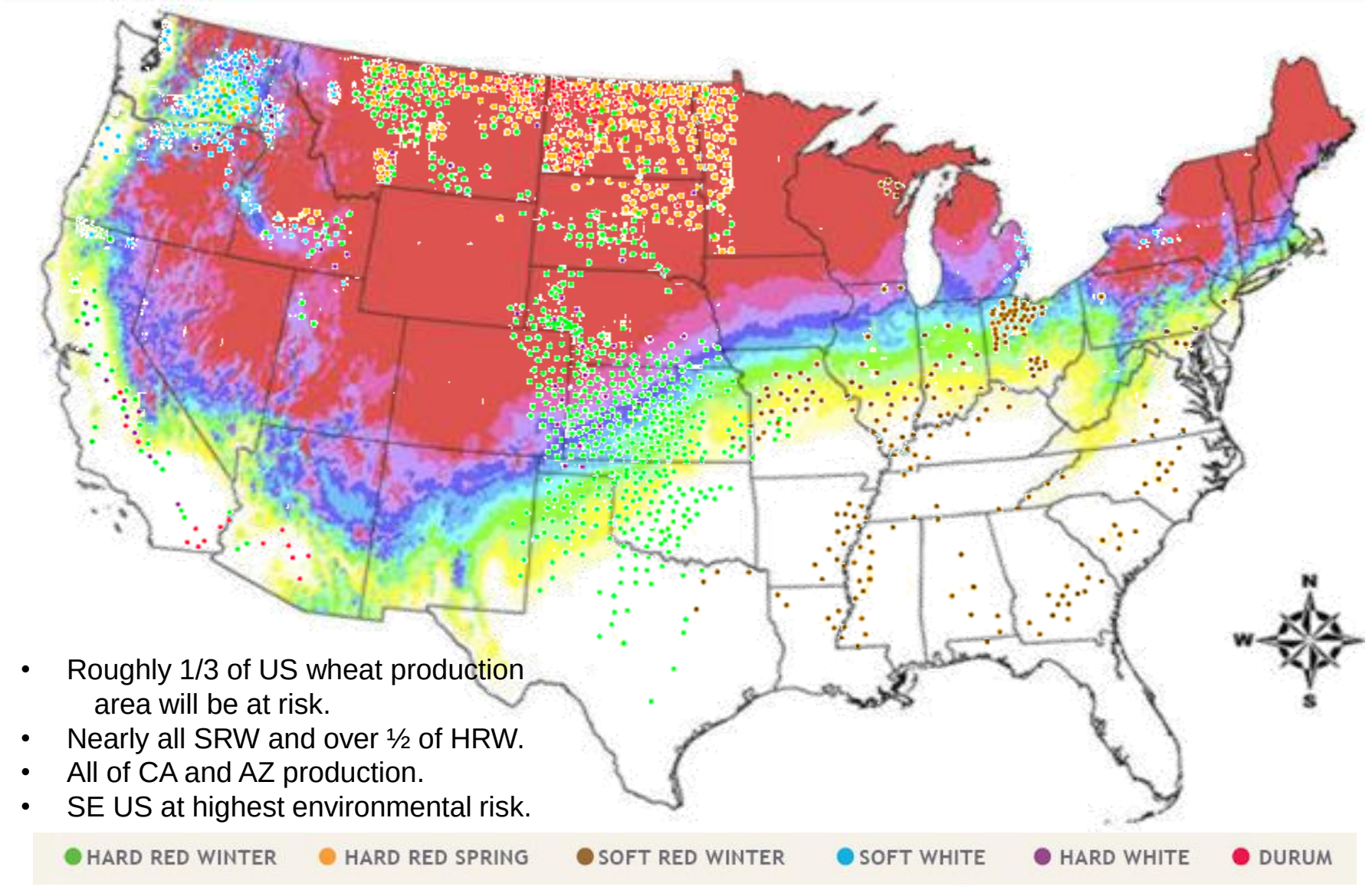

- Roughly 1/3 of US wheat production area will be at risk.
- Nearly all SRW and over ½ of HRW.
- All of CA and AZ production.
- SE US at highest environmental risk.

http://www.uswheat.org/wheatClasses

NIFA Blast Integrated Project