International Wheat Yield Partnership

Research to Deliver Wheat for the Future

International Wheat Yield Partnership

Research to Deliver Wheat for the Future

- Richard Flavell, Member of Science and Impact Executive Board
- Hans Braun, CIMMYT
- Mike Robinson, Syngenta Foundation for Sustainable Agriculture
- Steve Visscher, BBSRC
- Nora Lapitan, USAID

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Goal

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To increase wheat yield potential by up to 50 percent in 20 years:

- Exploit the best relevant science base worldwide
- Incorporate and evaluate in elite germplasm
- Transfer germplasm to leading relevant breeding programs around the world (public and private)

- To be inspired and managed by an independent management team and structure, linked with the private sector and developed with state of the art technologies

- To be focused on delivery with a high degree of urgency

Why now?

- Demands for wheat are increasing
- Gains in breeding programs around the world have slowed to dangerous levels
- New interest from private sector and governments
- Many helpful initiatives around the world in yield protection e.g. in disease control but fewer in yield potential
- New technologies and scientific discoveries offer new possibilities

Why now?

- Unprecedented progress in underpinning science in discovery and breeding methods e.g. genome sequencing, marker assisted breeding and genomic selection in many crops
- Many relevant discoveries are emerging that could be built into wheat e.g. photosynthesis
- Breeding, dissemination, re-breeding into varieties and evaluation in many environments takes time

Technical Committee

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- A Technical Committee met to address how to increase substantially the genetic yield potential of wheat and produced a report
- Six themes were recommended around the concept of creating plants that act as better photosynthesis machines
- These were similar to what had been selected previously by CIMMYT and colleagues as part of the Wheat Yield Consortium

Carbon Fixation and Grain Yields

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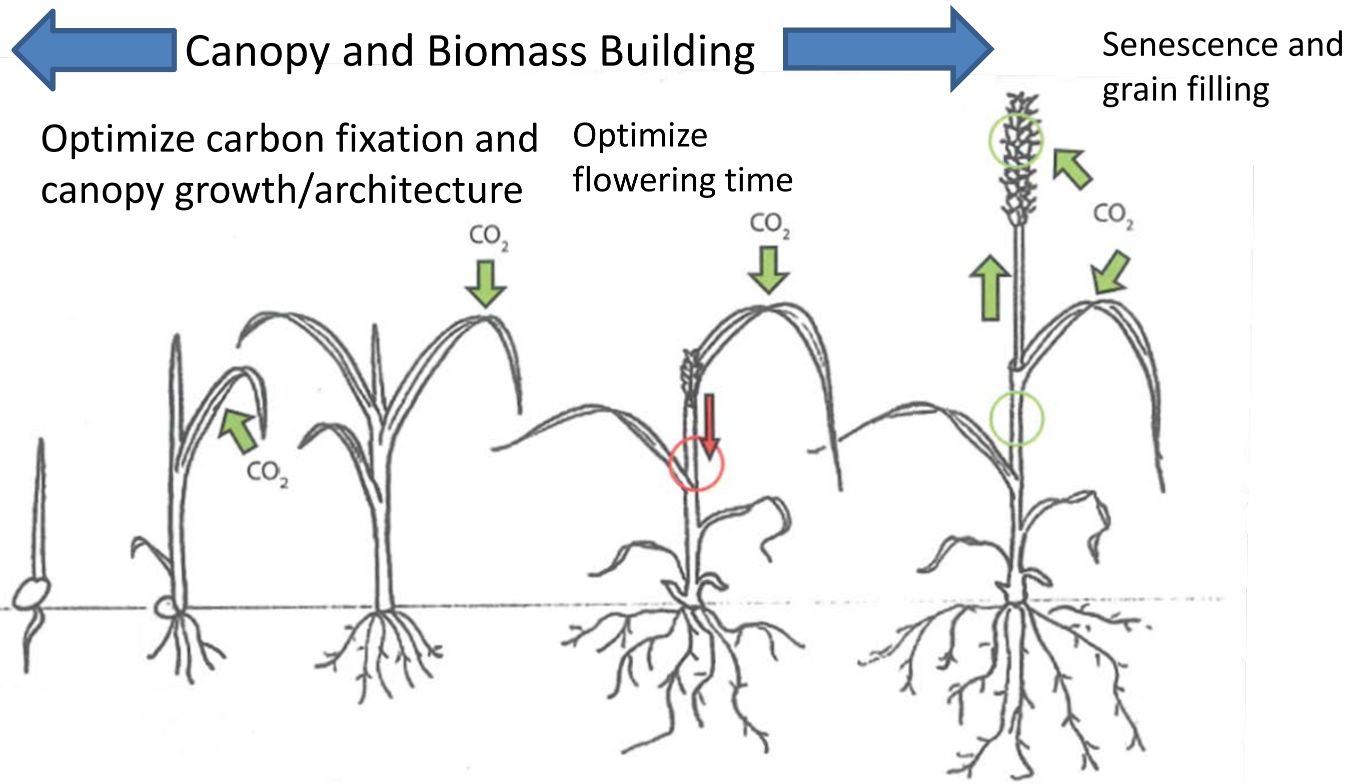

Figure 3. Stages of development in a cereal crop are shown where provision of sufficient photosynthate can have major effects on yield potential. Photosynthetic activity of the first source leaves can drive early canopy closure, and carbon fixed pre-anthesis can be stored in stems (red arrow and circle) and later remobilised (green circle). Persistent photosynthetic leaf area late in grain-filling (or 'staygreen') can 'finish' the crop.

Airborne Remote Sensing Platform for High Throughput Phenotyping

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Rapid screening for large trials:

Airborne measurements well-associated with ground-based data

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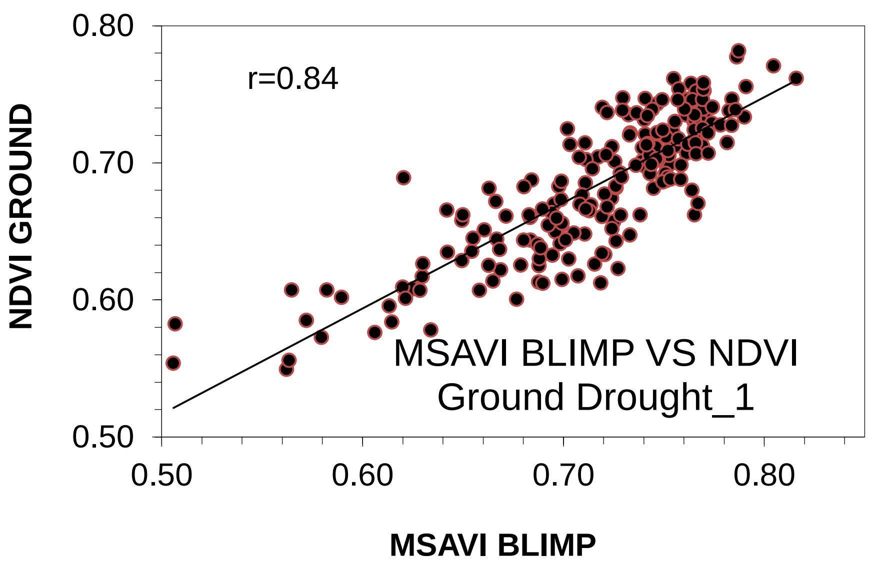

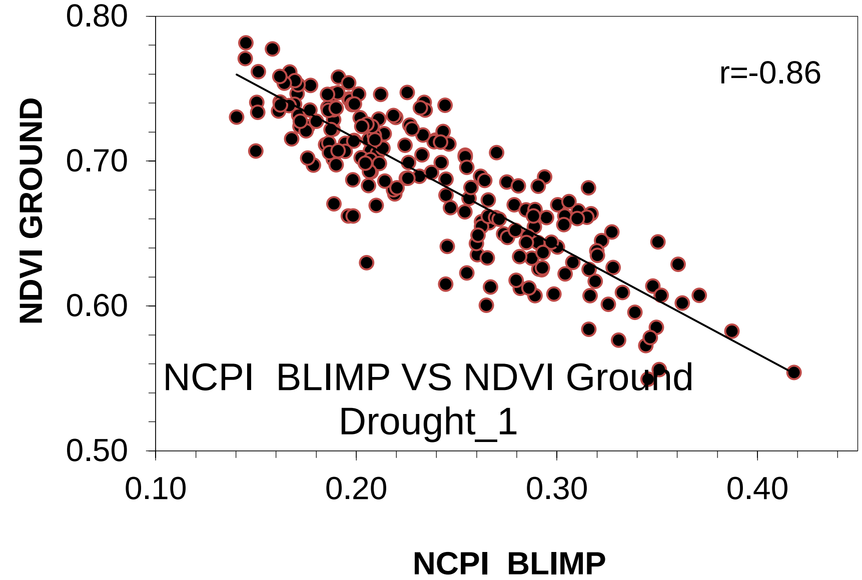

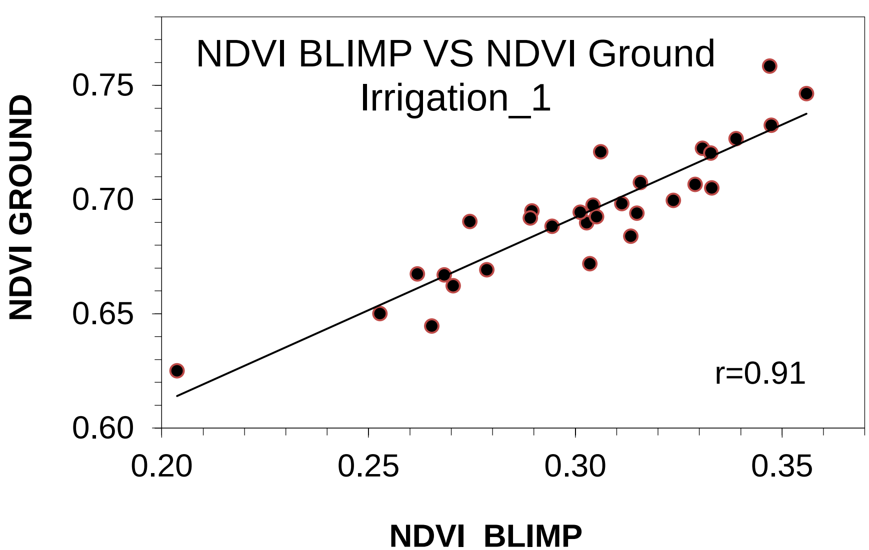

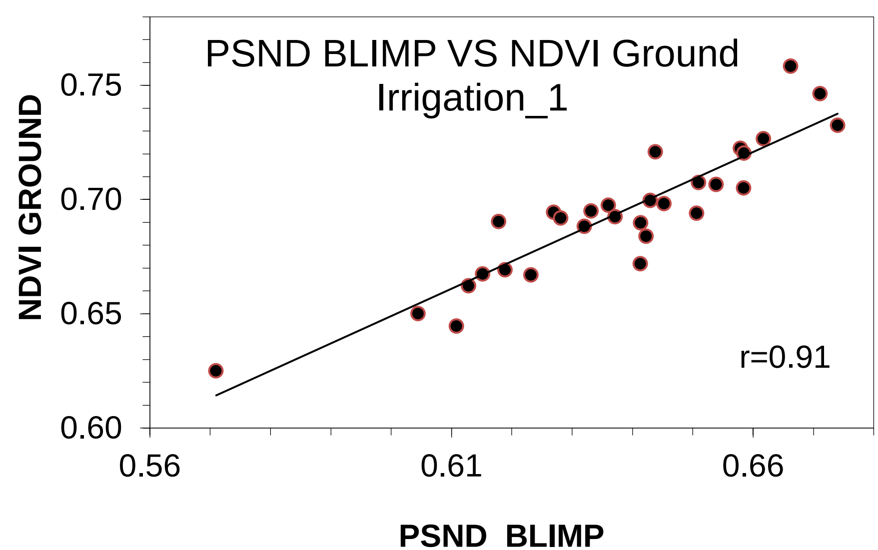

Opportunities Around the World

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- Screening new germplasm for higher biomass
- Screening wheat relatives for more efficient photosynthesis at multiple temperatures
- Selecting variant architecture, e.g. awns with high photosynthetic outputs
- Looking for variant Rubisco enzymes in wheat relatives
- Selecting better Rubisco activase genes
- Changing Rubisco genes
- Improving the efficiency of regenerating Rubisco substrate

WHEAT DESIGN: Available genetic variation in DM partitioning 7 days after anthesis (%)

Bars represent genetic range

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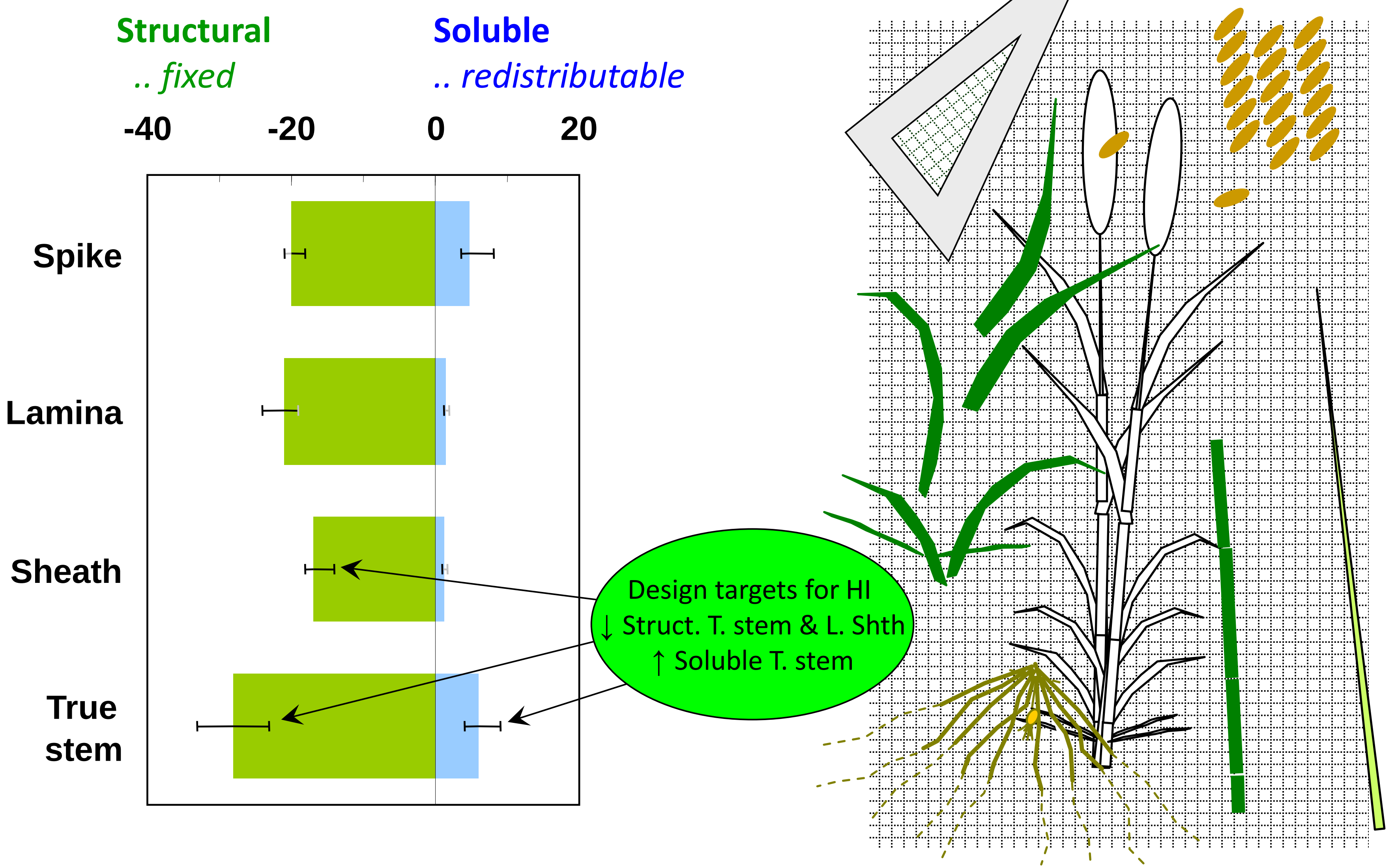
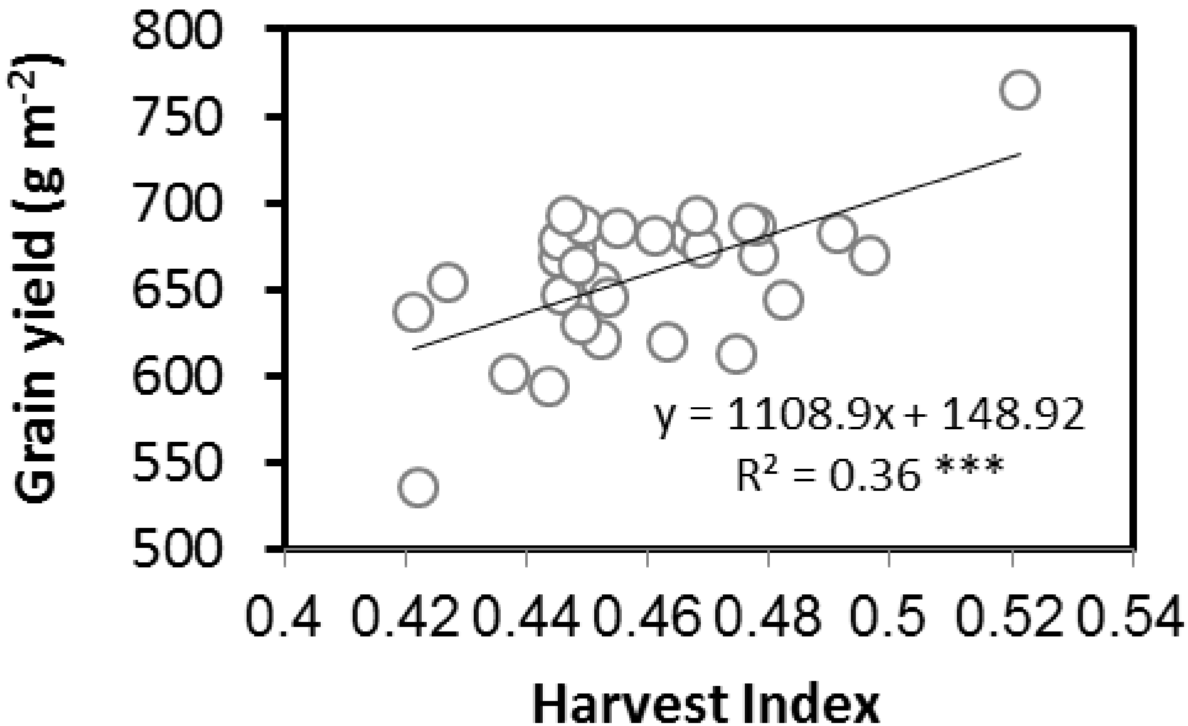


C. Rivera, E. Trujillo, M Reynolds, R Sylvester-Bradley, G. Molero, J Foulkes.

9 CIMCOG cultivars raised beds, 2011-12 and 2012-13.

The University of Nottingham | CIMMYT International Maize and Wheat Improvement Center | ADAS

Variation in Harvest Index and Yield



From Foulkes et al, Nottingham University

To Drive Traits Towards the Market

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- Define genetic basis of each trait using markers
- Transfer trait(s) to elite germplasm using markers
- Stack traits to create super engine, optimizing phenology and harvest index
- Evaluate germplasm in field settings
- Pre-breed and select
- Release to worldwide breeding programs

Six Project Areas

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- A and B: Improving light capture and conversion into more biomass during growing season using:
  - wheat and wheat related genetics
  - proven transgenes
- C: Maximizing grain yields from increased biomass by maintaining or improving harvest index
- D: Building elite, improved lines for transfer to other breeding programs
- E: Taking advantage of discoveries from other initiatives
- F: Breakthrough technologies for wheat breeding

Integrated Technologies for a World Class Program

To aid management of traits in breeding programs the Hub needs to have, or be linked to, up-to date very high-throughput marker analysis platforms

- Up to date markers from worldwide programs
- Efficient phenotyping platforms
- Leading computational biology and trait breeding systems

IWYP Breeding and Research Hub

CIMMYT-Mexico

Access governed by SIEB

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Critical Mass of Physiologists, Geneticists, Breeders and Support Staff

State-of-the-Art High Throughput Field Phenotyping Platform for Trait Validation

Genotyping Platforms / Marker Library

Trait Introgression Platform (via the Mexico-CIMMYT Shuttle)

Bio-Secure Transgenic Testing Platform

Hosting and Support Services for IWYP Partner Experiments

Data Management/Sharing and Technical Cooperation

Integration with WHEAT IWIN and National Programs

How will IWYP interact?

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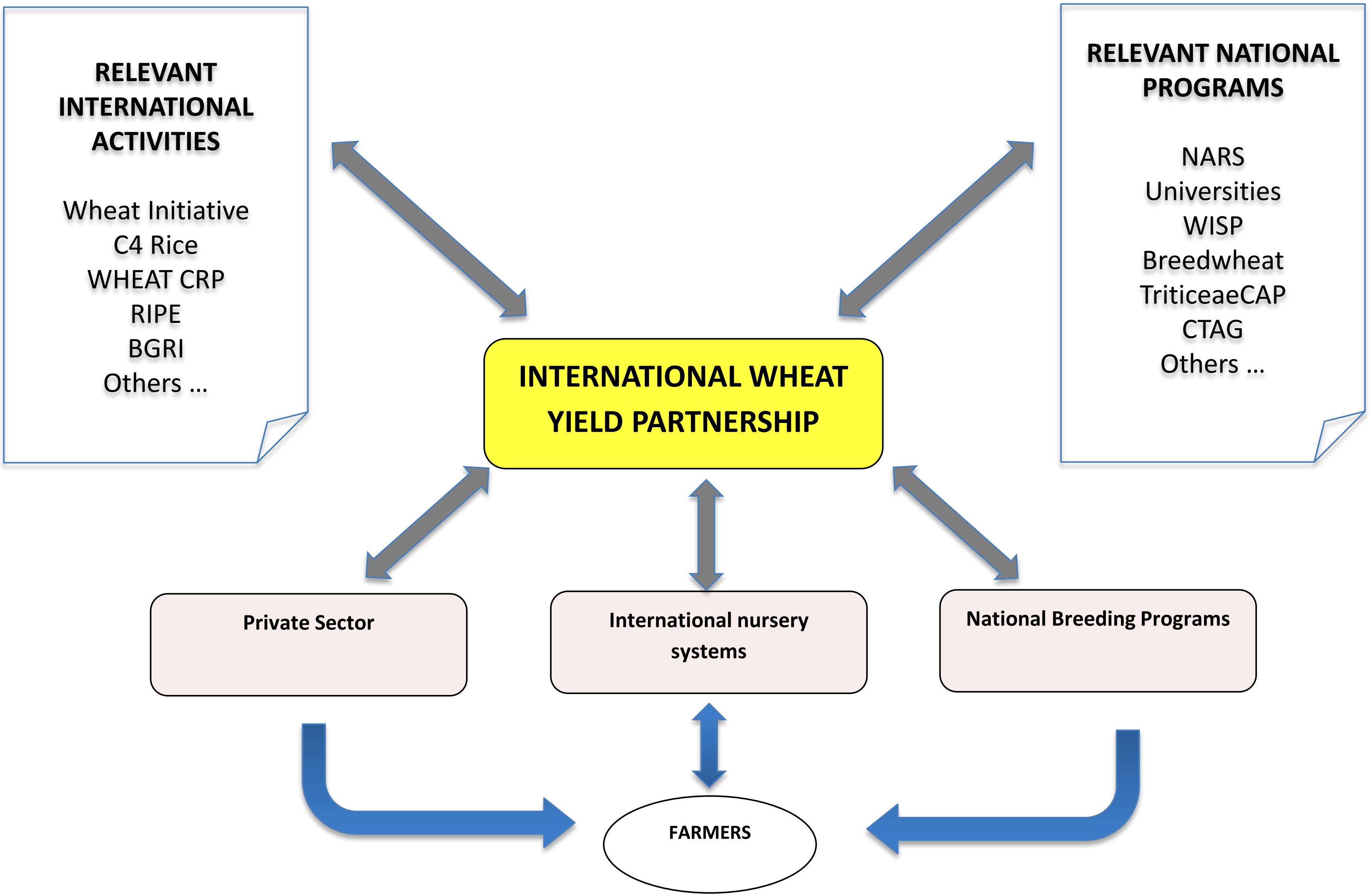

Private Sector Engagement

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- Aim: to partner in guiding, assessing and assisting the research program and the broad deployment of outputs of the IWYP
- Contributions: advise the Executive Board in priority setting, sharing of germplasm, technology services and product development
- Benefits: early insights, access to grants process, networking
- Membership fund: will cover the overheads of the PPP
- Intellectual property: wheat material under development produced by the IWYP would be available for use as parental breeding material subject to an appropriate material transfer agreement

Public Private Partnership

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A number of companies have expressed interest, some have already applied for membership:

- Bayer Cropscience
- Caussade-Semences
- Dow Agrosciences
- DuPont Pioneer
- InterGrain
- KWS
- Lemaire Deffontaines
- Limagrain
- Momont
- Nordsaat
- Saaten Union Recherches
- SECOBRA Recherches
- Syngenta

Organizational Structure

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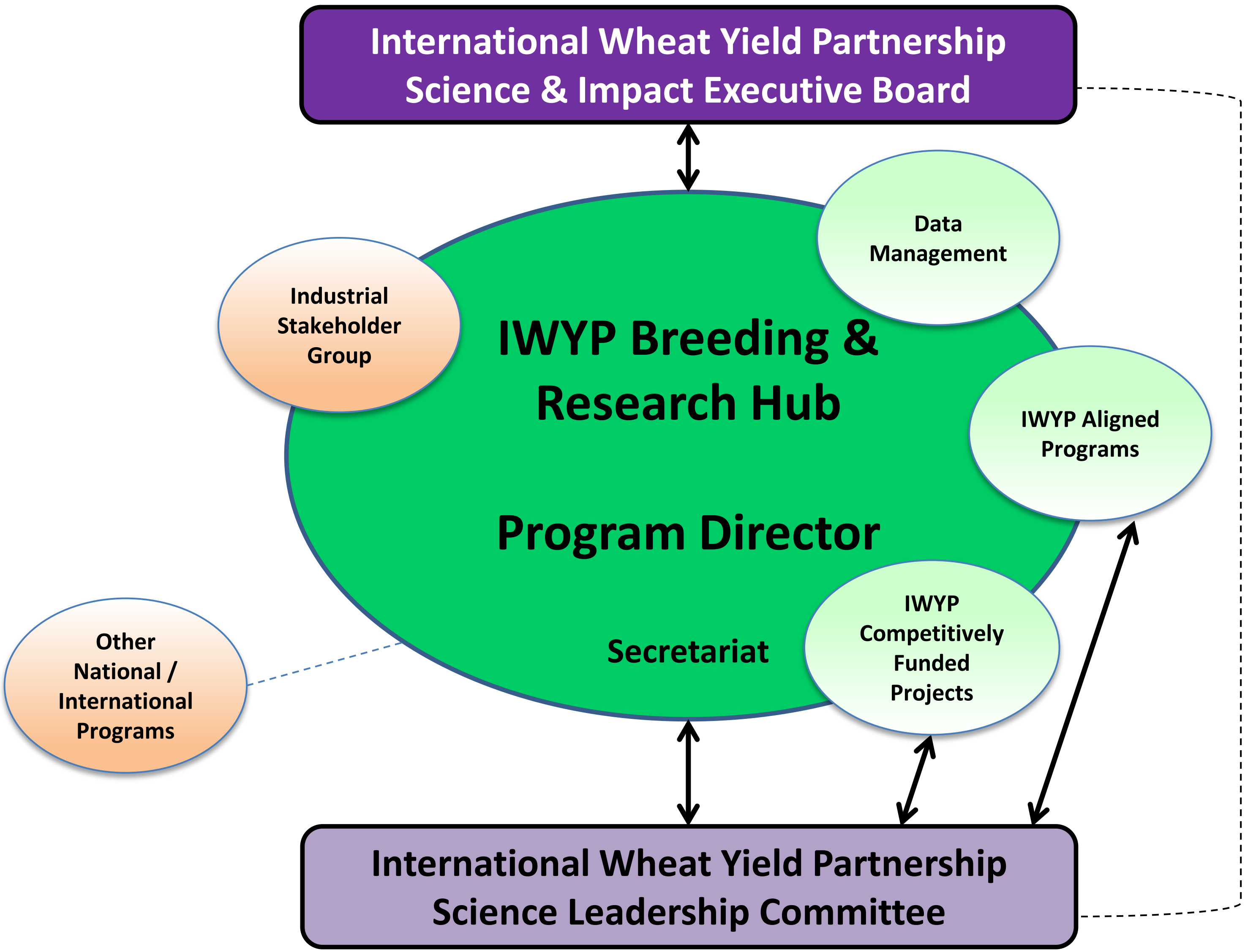

Program Plans

Year 1

- Launch IWYP
- Develop PPP
- Appoint Director
- Establish SIEB
- Establish Hub
- Establish SLC
- Launch 1st Competitive call

Year 2

- Launch 2nd Call
- Launch Program F

Years 3 - 5

- Outputs
- Outcomes
- Dissemination

Engage with other Programs and Develop New Partnerships

Progress and Future Plans

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Funding is in place to:

- Appoint the IWYP Program Director
- Establish IWYP Breeding Hub at CIMMYT
- Launch Initial call(s) for proposals
- Establish Science and Impact Executive Board - funders, leading scientists from public and private sectors
- Establish Scientific Leadership Committee

- Flexible mechanisms to allow funding partners to contribute resources
- Seek additional partners from all sectors

- **We are receptive to ideas and welcome feedback**

Benefits to Developed and Developing Countries and their research

- Development of a strong global wheat public-private research community that share resources, capabilities, data and ideas to improve wheat yield potential
- Transforming the way wheat researchers work, enabling the fast generation of elite lines that are readily accessible to breeders
- Training of a new generation of breeders across the world
- New discoveries leading to new projects funded from other sources, leveraging initial investments

Increase in Cereal Production to Feed 9.6 Billion People by 2050

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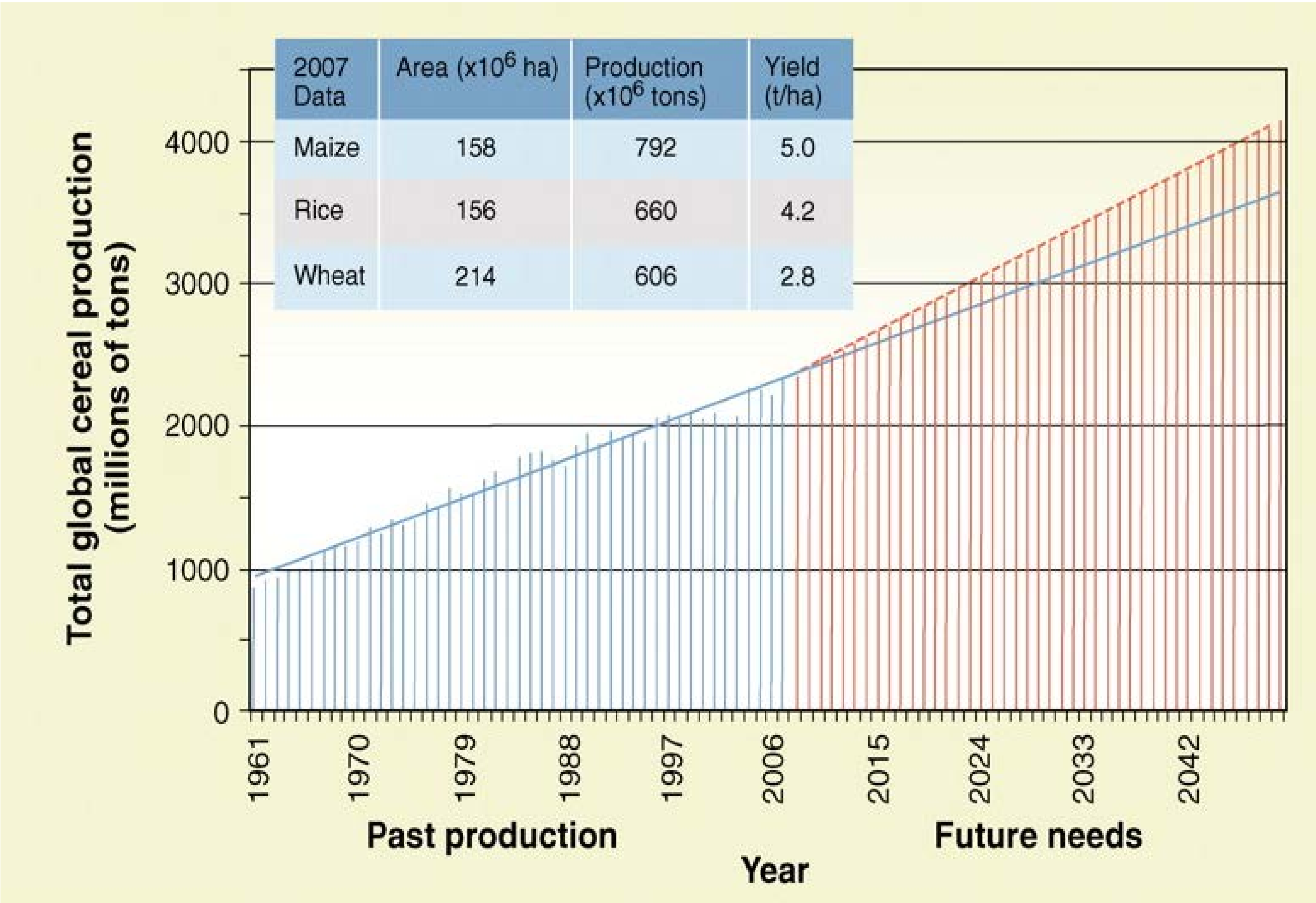

60% increase in wheat production to meet food demands by 2050.

Tester and Langridge. 2010. Science 327:818

Benefits to Developed and Developing Countries

Significantly increasing wheat yield potential could generate up to 160 million tons of wheat per year – or an estimated $50-100 billion in additional income annually.

"Take it to the farmers."

Norman Borlaug

IWYP has been developed in partnership

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BBSRC 20 Years of Pioneering Great British Bioscience

CIMMYT International Maize and Wheat Improvement Center

USAID FROM THE AMERICAN PEOPLE

GRDC Grains Research & Development Corporation

UKaid from the British people

?

syngenta foundation for sustainable agriculture

USDA

Australian Government

Australian Centre for International Agricultural Research

SAGARPA SECRETARÍA DE AGRICULTURA, GANADERÍA, DESARROLLO RURAL, PESCA Y ALIMENTACIÓN

CGIAR

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

teagasc Agriculture and Food Development Authority

Wheat Initiative

CONICET www.conicet.gov.ar

Institute of Crop Science, CAAS

HGCA

JIRCAS JAPAN

INRA SCIENCE & IMPACT

Embrapa

Q and A and Discussion

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Thank you for listening:

- **Q & A**
- **Discussion**
- **Feedback**

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