Impact of Wheat on Food, Nutrition and Health

Wheat is essential to global food and nutritional security

Wheat is the most widely grown of any crop globally (230m + ha) and accounts for:

- Over 21% food calories
- ~ 20% daily protein
The Problem – Urgent Need to Increase Wheat Yields to Feed 9+ Billion People by 2050

Will require a 60+ % increase in wheat production to meet food demands by 2050
Before IWYP, there wasn’t a mechanism internationally that enabled a system (for wheat or other crops) where the outputs of collaborative research could be leveraged into new germplasm and products for global benefit.

IWYP was conceived and operates as:

- An Associated Programme of the *Wheat Initiative* and the lead on delivering against Core Theme 1 of its Strategic Research Agenda

**IWYP is a partnership between:**

- Funding agencies in different countries
- Science teams in different countries
- Different research projects
- The public and private sectors
IWYP Private Partners (9)
IWYP Founders Sought to:

- Do things differently
- Operate with own / separate governance
- Accept high risk / high reward science - seek breakthroughs
- Take advantage of new technical opportunities
- Align and partner with other funded projects
- Focus on outputs that will have application to benefit farmers and consumers
- Take discoveries down the product development path (via links with CIMMYT and others) and deliver, exploit
IWYP Goal

To increase wheat yield potential by up to 50% by 2035 by:

- Deploying new model for funding, collaboration, coordination and development
- Linking with the private sector
- Capitalizing on state-of-the-art technologies
- Making step-changes in genetic yield potential
- Focusing on delivery with a high degree of urgency
- Pursuing specific scientific targets, strategic sharing, building on and integrating the discoveries
IWYP Investments in Program Areas to Date

CURRENT INVESTMENTS (April 2019)

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Total ~US$64.1m
Technology based

Trait and solution oriented

Product focused
IWYP Strategy

Enhance Photosynthesis to Drive Yield Increases

The IWYP Science Program

Our strategy to:
• Facilitate the sharing and integration of research, project outputs
• Time material inputs, manage capacities
• Realize synergies and generate added value
• Deliver traits and germplasm

Optimize carbon fixation and canopy growth/architecture
Optimize flowering time
Senescence and grain filling
IWYP is a Frontier Program for Making Breakthroughs in Wheat Yield Potential via:

- Discovery or creation of genetic variation in wheat that boosts the fixation of carbon into biomass for subsequent transfer to grains
- Maximizing grain yields from enhanced carbon capture and biomass through optimizing plant phenology
- Building elite lines for dispersal to other breeding programs
- Taking advantage of discoveries coming from other species
- Breakthrough enabling technologies to transform cereal breeding
Evaluation of Know Genes on Key Traits
Finding New Genes and Markers for Breeding
Finding Optimized Traits in Wheat Germplasm
Tools and Protocol Development
IWYP Science Program is made up of 35 “hand-picked” overlapping and/or complementary research projects, conducted by top international scientists, working collaboratively to create pre-products:

- 1\textsuperscript{st} IWYP Call Projects (8)
- NIFA-IWYP Call Projects (6+1 CAP)
- IWYP Aligned Projects (9+5)
- 2\textsuperscript{nd} IWYP Call Projects (6)
- AAFC Call - 3 potential new projects

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IWYP is a Long Term Continuous Program with Multiple Research Components

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IWYP Scope Areas in Current Portfolio

Distribution of Major Research Areas in IWYP Portfolio (30 Projects)

- Enhancing photosynthetic pathways
- Increasing carbon capture before flowering
- Increasing plant biomass
- Specific changes in plant architectures
- Increasing carbon flow into grains
- Optimizing harvest index
- Traits and markers for yield components
- Modifying phenology
- Enabling technology development
- Hybrid wheat development
- Root structure and growth
- Faster/alternative breeding methods
- Modelling to define optimal trait combinations

Number of Projects

0 1 2 3 4 5 6
Current IWYP Global Research Network
IWYP HUB – Validation and Development

**HUB Platform approach for Translation**

- Brings all discoveries into a single central source to compare and combine to seek synergies and generate added value
  - Trait validation
  - Precision phenotyping
  - Field evaluation
  - Prebreeding
  - Trials and distribution (via IWIN, directly)
- Enables IWYP to drive the discoveries/traits toward the market
IWYP Deploys Gene / QTL / Trait Assembly Lines

Higher Photosynthesis QTLs/Genes → Higher Photosynthesis Transgenics → IWYP HUB and/or INDUSTRY

Hybrid → Higher Biomass QTLs/Genes → Higher Biomass Transgenics → IWYP HUB and/or INDUSTRY

Genes/QTLs Larger/More Grains

Source

Sink

Higher Yield Elite plants
IWYP Sorts, Assembles and Scales the Trait / Marker / Tool Outputs to Maximize Impacts

IWYP Hub

Research Projects
- Ideas
- Discovery
- Proof of Concept assessments

Delivery of Elite Lines
(via IWIN, directly to others)

Field Trials
Prebreeding
Validation

IWYP Hub

Roots
Technology
Spikelet Fertility
Architecture
Photosynthesis
Harvest Index
Biomass
Makers/QTL for yield components
Grain size
Energy Use Efficiency
Phenology
Harvest Index
Combining Optimized Traits by Design to Build Higher Yielding Wheats

Sink Traits

Grain Size, Weight, Number; Increased Spikelet Number

Harvest Index

Partitioning of Captured C to Grains

Source Traits

Biomass, Canopy Architecture & Phenology Traits

RUE, EUE, Photosynthetic Induction

Root Architecture

www.iwyp.org
**Phase I**  *Discovery Research* - Focused coordinated research in the best wheat laboratories and field plots of the world to develop breakthroughs for crop improvement

**Phase II**  *Development of New Genetic Resources* - Collation of the results and their translation into prebreeding in commercially relevant environments in Mexico, USA and Europe

**Phase III**  *Delivery of Higher Yielding Germplasm* - Deployment of improved pre-products to NARS organizations and public or private seed companies for them to select the most locally adapted high yielding line to breed with or submit directly for commercialization
The IWYP R&D Pipeline – Organization, Tracking, Decision Making and Delivery Scheme

IWYP STAGE GATE PROCESS

Phase I

- STAGE 0
  - Research & Discovery

  - GATE 1
    - Target selected, passes screen in lab/GH/field

- STAGE 1
  - Proof of Concept

  - GATE 2
    - Significant effect measured in experiments (lab/GH/field)

Phase II

- STAGE 2
  - Validation

- STAGE 3
  - Prebreeding

  - GATE 3
    - Effect confirmed in Hub evaluations

  - GATE 4
    - Effect confirmed in elite germplasm at Hub

Phase III

- STAGE 4
  - Field Trials

- STAGE 5
  - Delivery & Breeding

  - GATE 5
    - Effect confirmed in multi-location field trials
Lines with single or stacked yield traits in a high yielding background, supporting data and methods to phenotype/genotype the traits

Introgression of traits and stacking into elite lines

Higher yields
Outcomes and Impacts

- Improvements based on:
  - Environmentally sound principles
  - Lower inputs with higher yields
  - Less land requirements
  - More efficient designs
  - Mitigation of climate change impact on yields

- Designed to meet food and nutritional security needs of planet with more people and less land

- Seeks to make wheat farming more economically sound
Learn More About IWYP

- Go to the IWYP website [www.iwyp.org](http://www.iwyp.org)

- **IWYP Strategic Plan 2017-2022** (Full and Summary versions) published on the IWYP website

- **IWYP Annual Reports** published on the IWYP website:
  - 2015/16
  - 2016/17
  - 2017/18
Thank You

iwypprogdirector@iwyp.org
iwypprogmanager@iwyp.org
www.iwyp.org