Julius Kühn-Institut
Bundesforschungsinstitut für Kulturpflanzen
Federal Research Centre for Cultivated Plants

Enhancing drought stress tolerance by harnessing genetic resources

Gwendolin Wehner

WHEAT INITIATIVE

Institute for Resistance Research and Stress Tolerance

Challenges

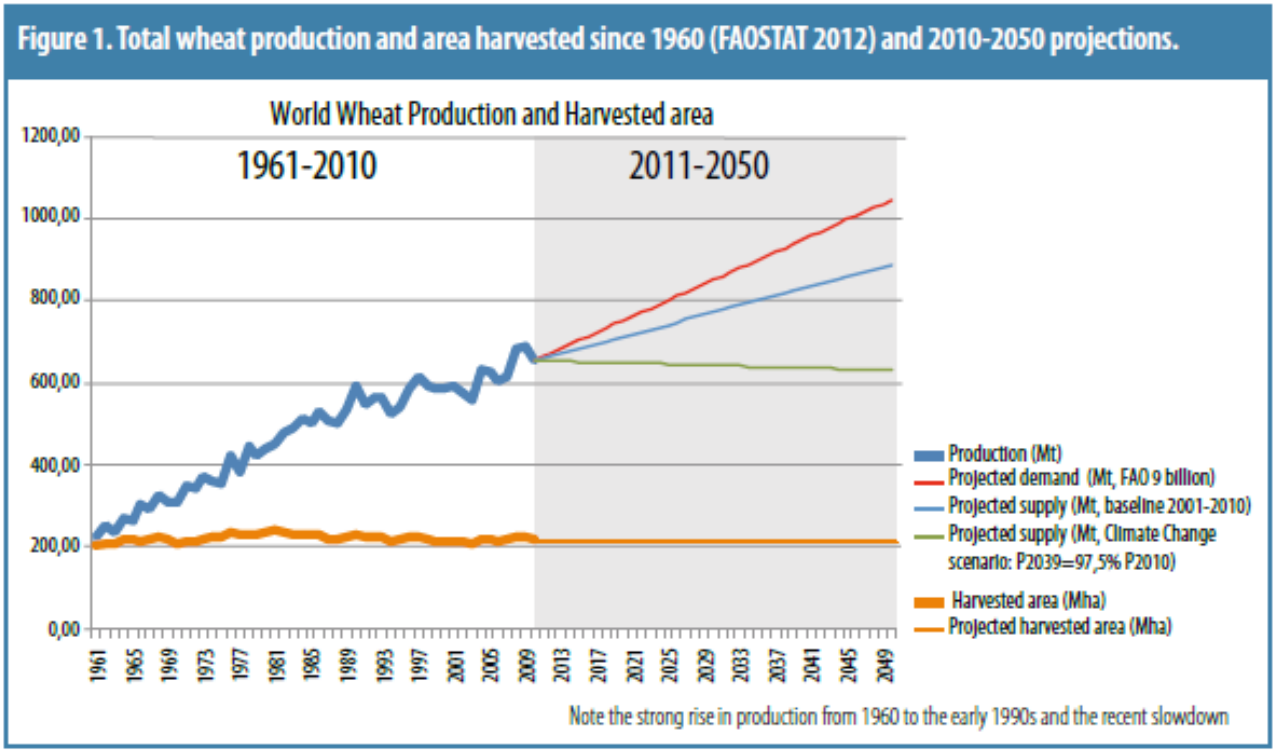
Financing for Development Office
Department of Economic and Social Affairs
United Nations

World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100

21 June 2017, New York

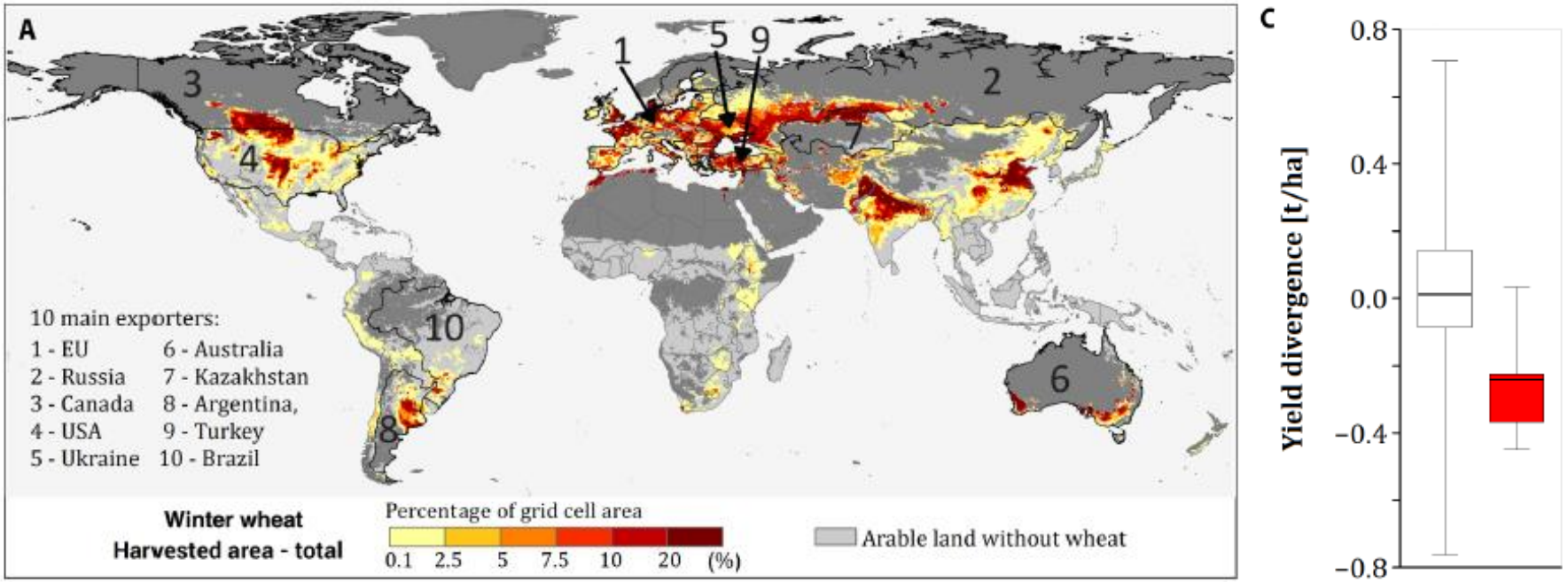
The current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100, according to a new United Nations report being launched today. With roughly 83 million

Figure 1. Total wheat production and area harvested since 1960 (FAOSTAT 2012) and 2010-2050 projections.



Wheat Initiative (Vision paper)

Drought



Trnka et al. 2019, Science Advances

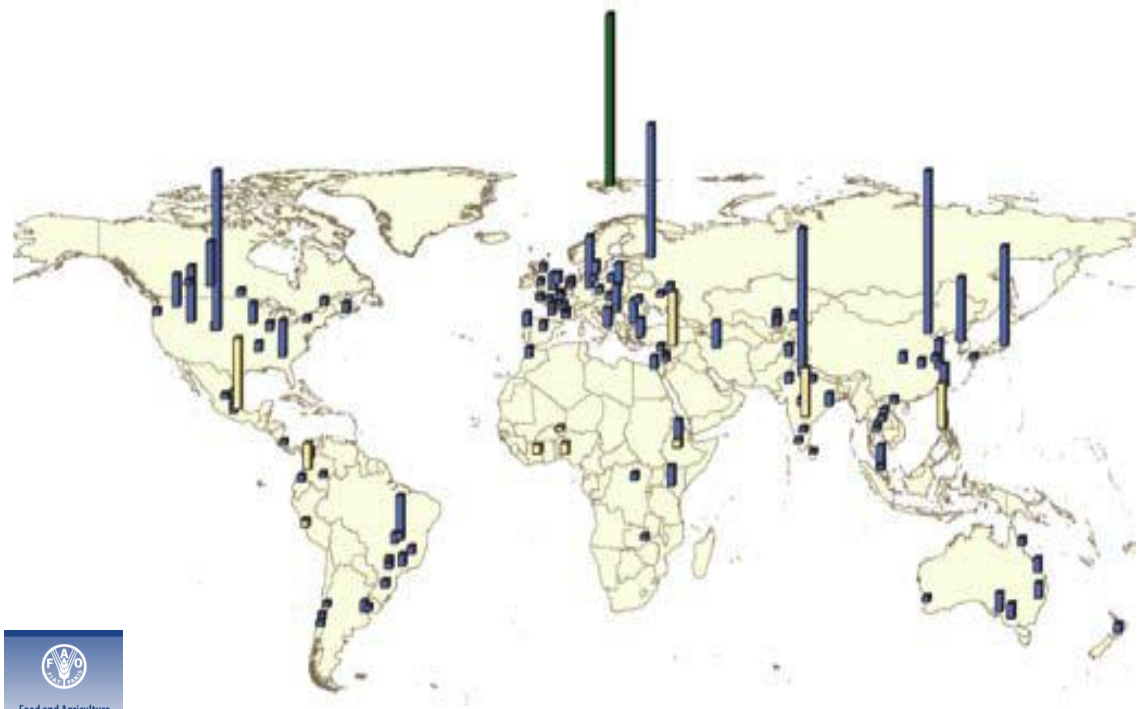
Most important wheat-growing areas and the effect of SWS on wheat yields

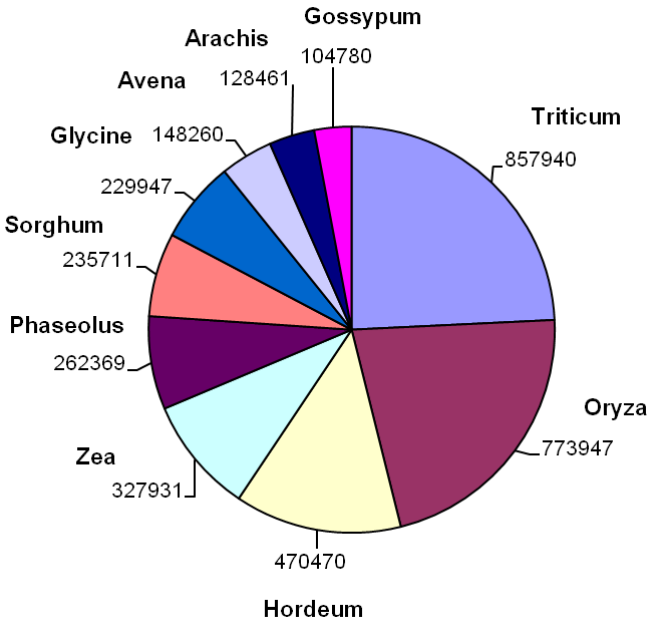
Comparison of wheat yield deviations during years with and without severe water scarcity (SWS) occurrence, combining the 10 main wheat exporters. SWS and yield data over the period 1991–2016 were used.

Genetic Resources

1.750 genbanks worldwide, 7.4 million accessions

130 genbanks hosting more than 10.000 accessions





10 species = 3,540,000 accessions
~ 50% of the ex situ resources

Food and Agriculture Organization of the United Nations

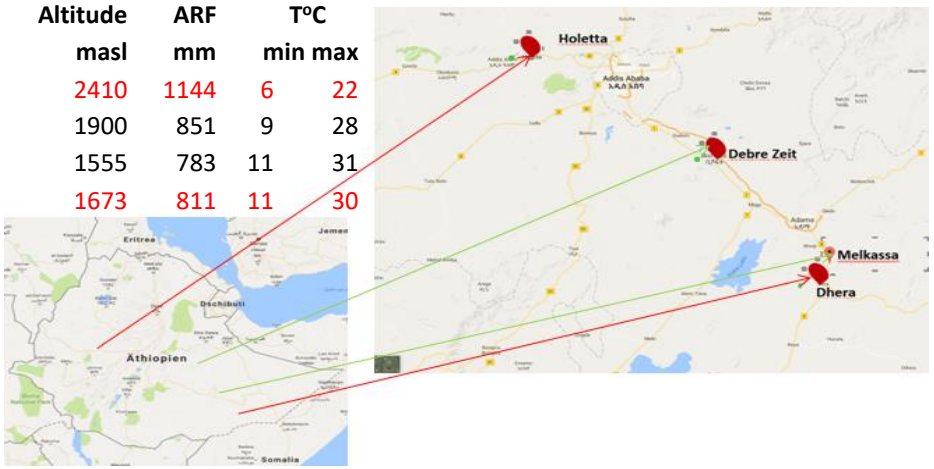
Analysing genetic ressources for drought stress tolerance

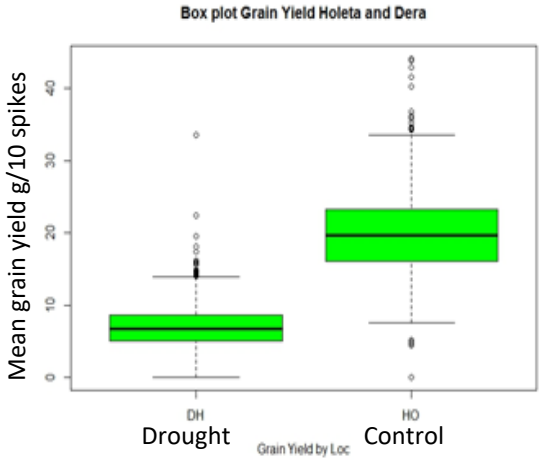
II. Screening of Ethiopian durum wheat and barley accessions under naturally occuring Drought stress

Genome wide association studies to improve drought stress tolerance in Ethiopian durum wheat (Triticum durum) and barley (Hordeum vulgare) accessions

Kefyalew Negisho, Surafel Shibru, Doris Kopahnke, Frank Ordon and Gwendolin Wehner

Sites	Altitude masl	ARF mm	T°C min	T°C max
Holeta	2410	1144	6	22
Debre Zeit	1900	851	9	28
Melkassa	1555	783	11	31
Dera	1673	811	11	30





III. Mapping of drought stress tolerance in wild emmer of an Israeli landrace population

Analysis of genomic regions for drought stress tolerance in Wildemmer

Mathieu Deblieck, Fatihua Andrii, Yehoshua Saranga, Tamar Krugman, Klaus Pillen, Frank Ordon, Dragan Perovic, Assaf Distelfeld and Vered Barak

- → QTL at 2BS 13 Mil. Basepairs of a RIL population
- → Crossing activities with a german elite wheat variety are in progress

Position of the molecular markers in the genetic map

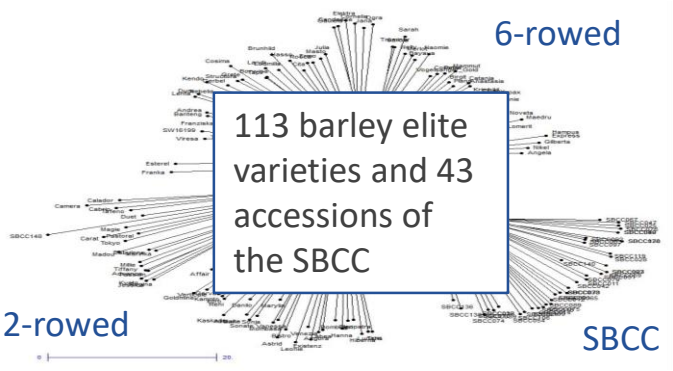
-plant-ID	32.88	35.44	36.48	39.36	40.75	42.15	43.95	4
1663-G	G	U	U	U	U	U	U	
1688-C	G	U	U	U	U	U	U	
1488-A	G	U	U	U	U	U	U	
1324-H	G	G	U	U	U	U	U	
1767-E	G	G	G	U	U	U	U	
1174-B	G	G	G	U	U	U	U	
1792-D	G	G	G	U	U	U	U	
1704-C	G	G	G	U	U	U	U	
1029-B	G	G	G	G	G	U	U	
1115-A	G	G	G	G	G	U	U	
1735-E	G	G	G	G	G	G	U	
1121-B	G	G	G	G	G	G	U	
1539-A	G	G	G	G	G	G	G	
1004-B	G	G	G	G	G	G	G	
1329-A	G	G	G	G	G	G	G	
1929-C	U	G	G	G	G	G	G	
1695-C	U	U	G	G	G	G	G	
1005-C	U	U	U	G	G	G	G	
1431-G	U	U	U	G	G	G	G	
1794-D	U	U	U	G	G	G	G	
1761-D	U	U	U	U	G	G	G	
1117-F	U	U	U	U	U	G	G	
1145-C	U	U	U	U	U	G	G	
1766-G	U	U	U	U	U	U	G	
1336-E	U	U	U	U	U	U	G	

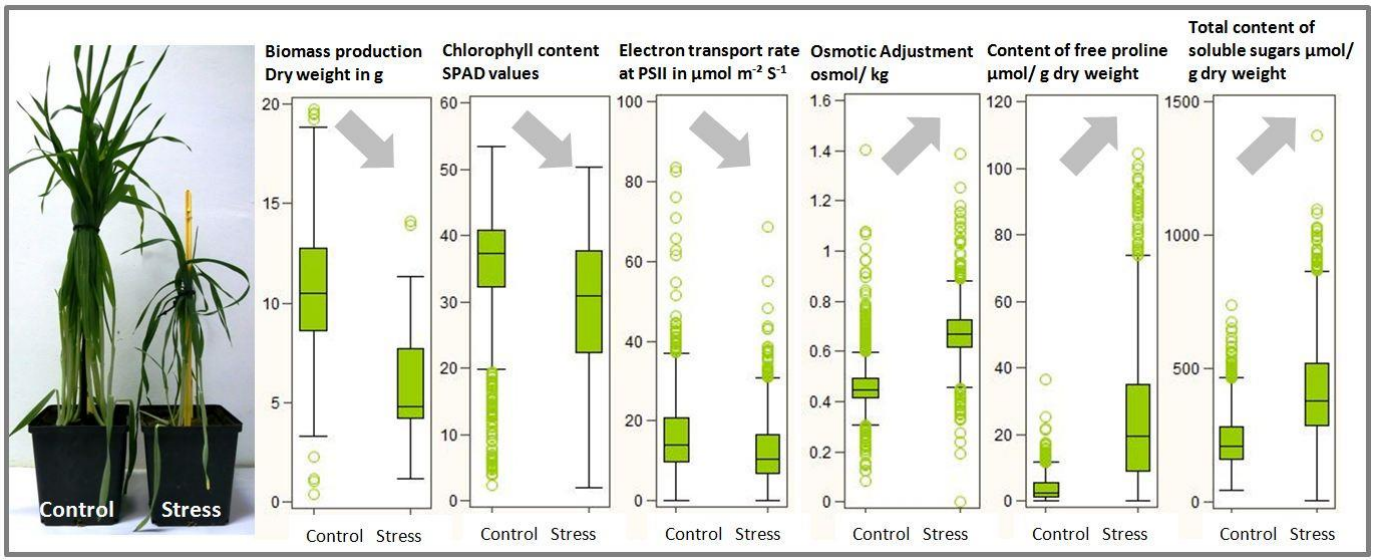
Peleg et al. 2005

III. Screening of winter barley accessions under drought stress application in pot experiments

Identification of genomic regions for drought stress induced leaf senescence using wild barley introgression lines and elite barley varieties

Gwendolin Wehner, Christiane Balko and Frank Ordon





Wehner et al. 2015, BMC Plant Biology; Wehner et al. 2016 BMC Plant Biology und Wehner et al. 2016, Agronomy

IZN Interdisciplinary Center for Crop Plant Research
MARTIN LUTHER UNIVERSITY OF HALLE-WITTENBERG

Conclusions

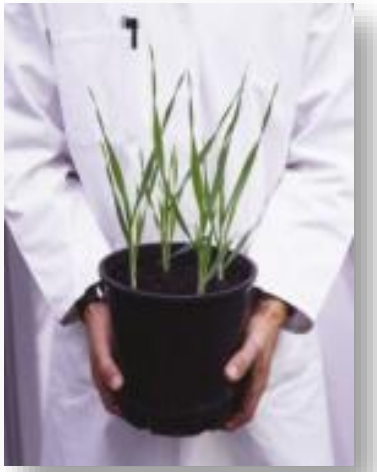
- Genotyping of large gene bank collections is technically feasible
- Genotypic data, in combination with geographic and other information, can be used to pre-select genotypes for detailed phenotypic analysis
- Phenotypic analysis for drought stress tolerance and of drought stress related traits is feasible
- Data storage and information systems are available
- Consequently, it is now practicable to efficiently harness genetic resources for breeding drought stress tolerant crops

But international collaboration, based on detailed discussions and planning, is now needed to achieve these goals.

WHEAT INITIATIVE

- Established in 2011, endorsed by G20 Agriculture Ministries

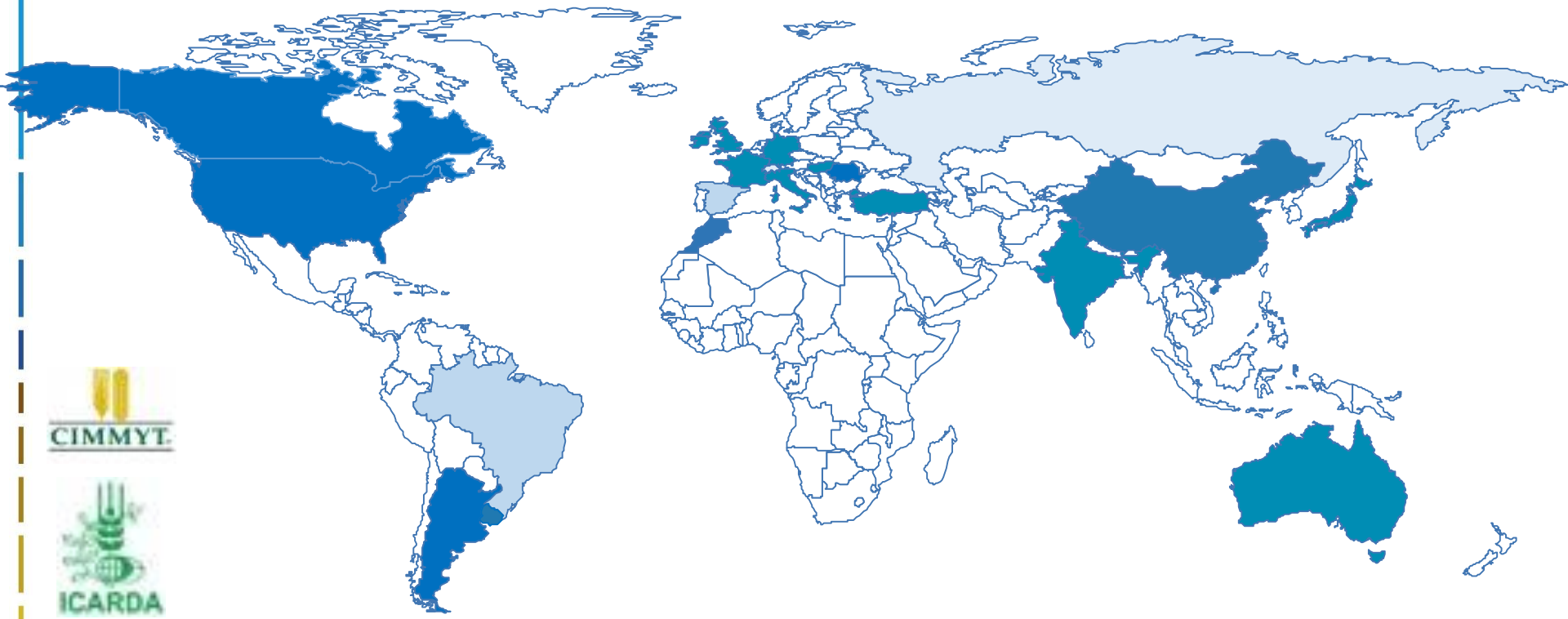
- A framework for wheat improvement at the international level
  - Identify synergies
  - Facilitate collaborations
  - Share resources and capabilities



Encourage and support the development of a vibrant global wheat research community sharing resources, capabilities, data and ideas to improve wheat

Members

16 countries, 7 private companies, 2 CGIAR Centres



CIMMYT

ICARDA

ARVALIS Institut du végétal

FLORIMOND DESPREZ

KWS

Limagrain

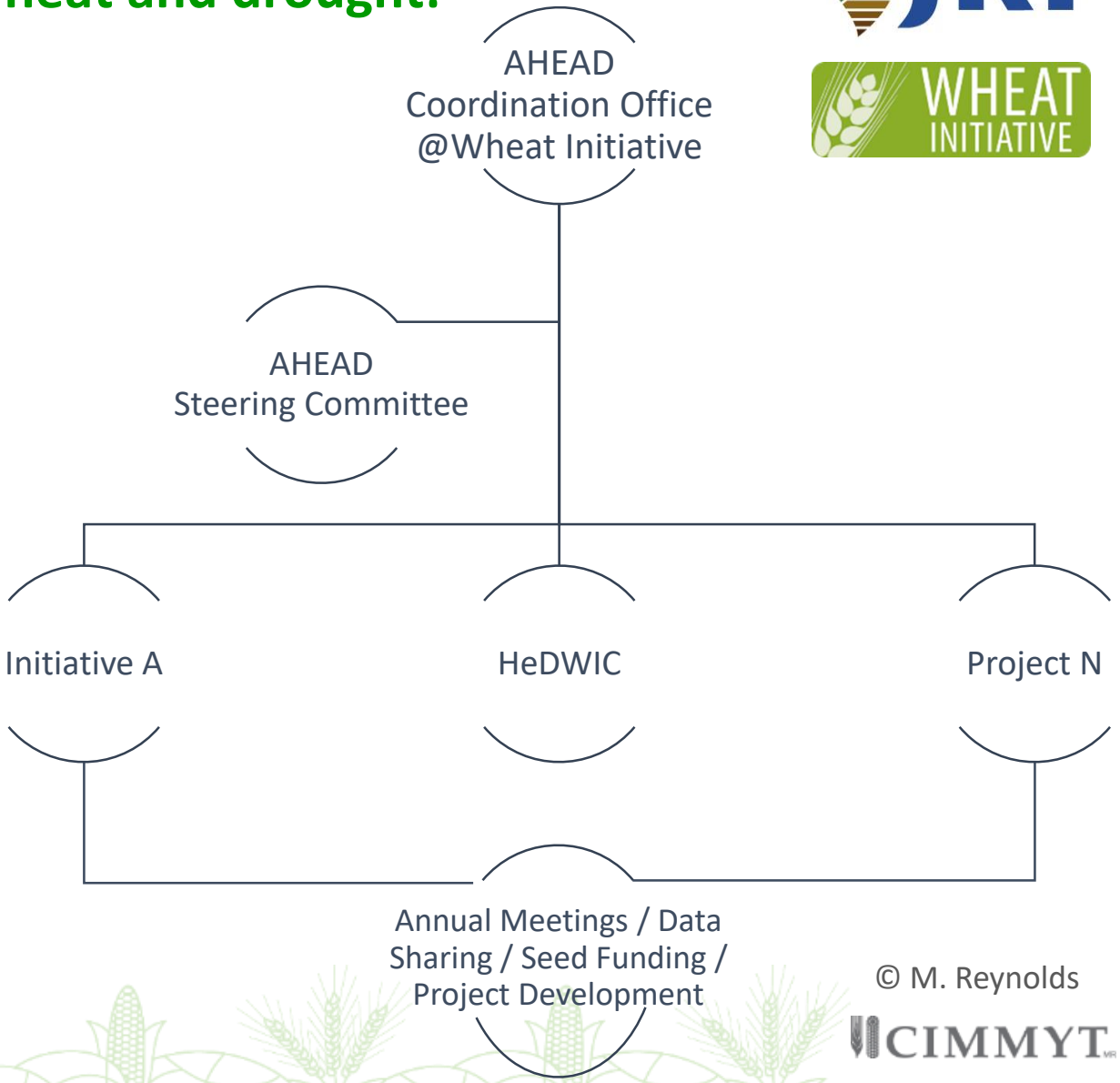
RAGT

SAATEN UNION

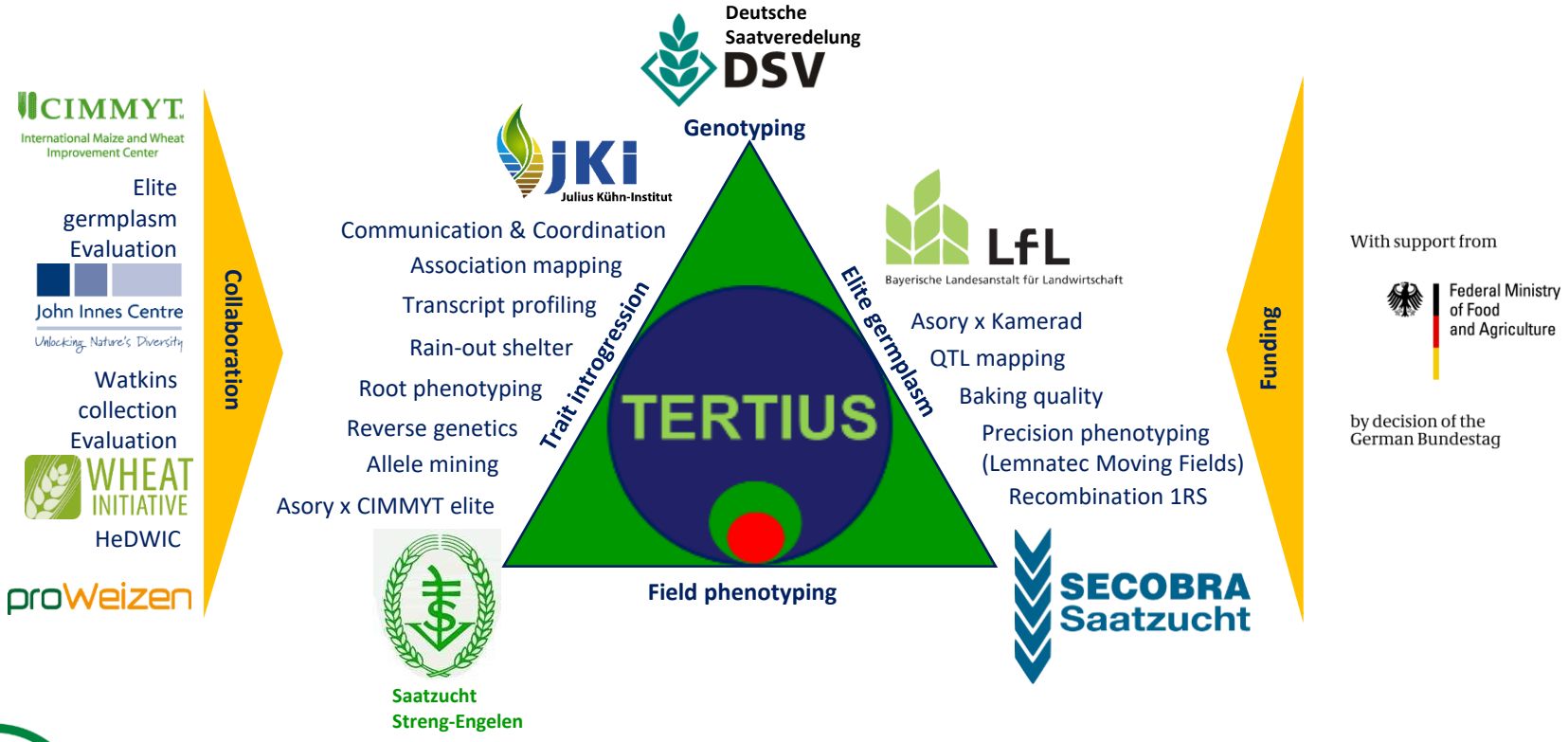
syngenta

Added value of HeDWIC and the AHEAD umbrella for heat and drought:

- **ALLIANCE FOR WHEAT ADAPTATION TO HEAT AND DROUGHT**
- **Catalyzing new research opportunities**
- **Disseminating new research and breeding technologies**
- **Leverage of institutional capital**
- **Translating research outputs of HeDWIC/AHEAD communities into breeding tools through translational research**



Genome-based strategies
to use the tertiary gene-pool for breeding of climate-smart wheat



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Federal Ministry of Food and Agriculture

Federal Ministry of Food and Agriculture (BMEL) organizes as a follow up event to the G20 workshop 2017

- Review the field of the importance of improving drought stress tolerance in crops for feeding the earth´s growing population against the background of climate change
- Discuss the most recent findings and new perspectives from exploring and valorizing the functional diversity of genetic resources via breeding for drought stress tolerance
- Strengthening international collaboration

Contact details

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