



Proposal number <sup>1</sup> : 2013 -01
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Date of reception <sup>1</sup> : 29/06/13
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<b>EXPERT WORKING GROUP TOPIC SUBMISSION<sup>2</sup></b>
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*Expert Working Groups (EWG) are established where a particular topic of direct relevance to the Wheat Initiative would benefit from bringing together experts in that specific field. The Wheat Initiative would provide them with a platform for discussion, information sharing, consideration of specific problems, identification of research priorities and gaps. The EWG should have clear objectives and these could include (but are not limited to) specific activities such as contributing to the development of the Wheat Initiative Strategic Research Agenda, producing a position paper for publication or addressing a particular challenge through a research programme. Each EWG will be established for an initial defined period. The minimum output should be annual reports to the Scientific Board for dissemination to the Research Committee, the Institutions' Coordination Committee and the wheat research community through the Wheat Initiative website.*

*Expert Working groups are established following the attached flow diagram. Organised consortia addressing wheat research challenges can be endorsed by the Wheat Initiative as EWGs following the same process. EWGs will be set up after approval of the submitted proposals by the Research Committee or the Institutions' Coordination Committee, each in its area of expertise (science or research organisation/funding). An open call for members of the EWGs will be organised on the Wheat Initiative website. Research priorities established by EWGs and endorsed by the Research Committee will constitute a port-folio that will be available to the Institutions' Coordination Committee members to tackle priorities together or independently in each country.*

Topic title		
"Wheat phenotyping to support wheat improvement"		
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<sup>1</sup> For Secretariat use only, do not fill

<sup>2</sup> Please send the completed form to H el ene Lucas, [Wheat.Initiative@versailles.inra.fr](mailto:Wheat.Initiative@versailles.inra.fr), under a Word format.

<sup>3</sup> Add lines for other proposers if needed.

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### Summary

Plant phenotyping is an essential requisite to all steps of wheat improvement, from the identification of genetic variability in donor germplasm via QTL mapping to the generation of training sets for Genomic Selection. The limiting step in all these processes is currently phenotyping because it is still time and labour intensive and thus costly. To reduce the gap between genomics and phenotyping for wheat improvement, we need to support and strengthen research initiatives in developing new technologies focused on wheat phenotyping on an international scale. In addition, we need to create tools that encourage sharing and publishing phenotyping results from wheat improvement studies and build research capacity through knowledge exchange and training.

## Detailed description (5 pages maximum)

### Rationale

To meet the rapidly growing food demand worldwide we need to significantly increase agricultural productivity of major staples like wheat. The generation of high yielding, resilient crops will be an essential component of this effort. Molecular breeding tools already help to accelerate this process, however, we still need to evaluate the performance of the wheat plants at several stages during the improvement program – i.e. we need to phenotype them and further elucidation of genetic bases depends on high quality phenotypic data in appropriate environments.

In recent years, there has been considerable effort to improve crop phenotyping research, using state-of-the art sensors, cameras and automation. Nevertheless, phenotyping still forms a bottleneck and will continue to do so in the future since whole plant phenotyping cannot be reduced to the scale of a multi-well plate.

In the coming years, progress in wheat phenotyping will be made by:

- (i) Improving the precision of current phenotyping techniques; e.g. through better site characterisation and environmental monitoring to improve genotype x environment modelling.
- (ii) Reducing the costs of phenotyping specific traits; e.g. by replacing chemical wet lab analysis for nutrient content and quality with hyperspectral sensing techniques.
- (iii) Allowing the assessment of traits currently not possible; e.g. non-invasive detection of root architecture and function.

While pre-breeding research and trait discovery have benefited from automated phenotyping facilities and high-resolution phenotyping in the field, the throughput of these approaches make them currently not suitable for the large scale required in many breeding programs. It is therefore necessary to answer the following questions:

- (i) Which phenotyping tools will be best used in trait dissection and pre-breeding to identify molecular markers that can be integrated into breeding programs?
- (ii) Which phenotyping tools have the potential for the throughput and low cost required for advanced breeding line evaluation?

The operation of high-throughput phenotyping facilities and the use of modern sensor technologies in the field highlighted that a crucial issue in capitalising on novel phenotyping tools is the handling of the large data volumes captured. Comparable to the efforts in bioinformatics in response to the -omics technologies, there is a need for a concerted effort to develop efficient tools for the analysis, storage and publication of high-throughput and high-resolution phenotyping data that will allow the conversion of phenotypic data into biological knowledge and ultimately improve our understanding of the traits contributing to yield and resilience.

Any progress in the development and adoption of novel phenotyping technologies relies on the collaboration of experts from various disciplines, such as crop physiology, mechanical engineering, computer vision, software development and statistics. Phenotyping, more than many other crop research areas, depends on the ability of plant scientists to engage experts from those disciplines and attract those students to pursuing research in crop phenomics. Progress in wheat phenotyping will depend on multi-disciplinary research teams and collaboration on an international scale.

<b>Description of the EWG aims</b>
<ul style="list-style-type: none"> <li>• Strengthen and support wheat phenomics research</li> <li>• Promote international collaborations and the development and exchange of expertise in wheat phenotyping</li> <li>• Enhance the integration of wheat phenotyping into breeding and genomics programs</li> <li>• Engage experts from non-plant disciplines in wheat phenotyping (e.g. computer vision, software engineering, database management)</li> </ul>
<b>Expected deliverables/outputs of the EWG</b>
<ul style="list-style-type: none"> <li>• Analysis of state-of-art in wheat phenotyping</li> <li>• Identification of research and infrastructure gaps in wheat phenotyping</li> <li>• Position paper with recommendations on future research priorities and investment required</li> <li>• Support of applications for funding in wheat phenotyping through expert advice and feedback</li> <li>• Application for funding to allow student and early career researcher placements in current phenotyping centres for training and collaborative projects</li> </ul>
<b>Timeline of Activities</b>
<ul style="list-style-type: none"> <li>• First meeting of all applicants at 3<sup>rd</sup> International Phenotyping Symposium (first quarter of 2014)</li> <li>• Analysis and position paper by Oct 2014</li> <li>• Support of at least two collaborative grant applications in 2014-2015</li> <li>• Application for exchange grants in 2014</li> <li>• Student and early career researcher placements in 2015</li> </ul>
<b>Alignment with the Wheat Initiative objectives</b>
<p>The proposed EWG aligns with the Wheat Initiative objectives by</p> <ul style="list-style-type: none"> <li>• Strengthening collaborations in wheat phenotyping on an international scale</li> <li>• Sharing expertise and phenotyping methods essential for wheat improvement programs</li> <li>• Encouraging communication between experts in wheat phenomics internationally</li> <li>• Establishing close links to breeding and genetics programs, e.g. through the wheat breeding EWG</li> </ul>
<b>Potential links with other Wheat Initiative activities</b>
<p>The proposed EWG will work closely with the Wheat Information System EWG on data storage and dissemination and with the Wheat Breeding EWG on integration of novel phenotyping strategies and expansion of existing protocols in current breeding programs.</p>
<b>Supporting countries/institutes</b>
<b>Potential participating countries<sup>4</sup></b>
<p>Australia, Saudi Arabia, France, UK, Germany, Mexico, USA</p> <p>Potential industry participants: Bayer CropScience, Limagrain, Syngenta</p>
<b>Resources (budget requirement, potential funders, etc.)</b>

<sup>4</sup> Not limited to current members of the Wheat Initiative

Resources will be required for travel of the proposers to the 3<sup>rd</sup> International Phenotyping Symposium in India in early 2014 for a one-day workshop.  
Follow-up meetings will initially be organised via phone conferences.  
A second meeting will be organised in 2014 to take place end 2014/early 2015 in conjunction with an international conference/meeting, such as the annual meeting of the WheatYield Consortium in Obregon.

**Planned duration of EWG (in years)**

Two years (2014-2015)

**Other comments**

**Date of submission to the International Scientific Coordinator**

29<sup>TH</sup> June 2013

NB: relevant accompanying papers (concept note, articles, research project,...) could be joined to the pro-forma.

# Wheat Initiative: process of establishment of a new Expert Working Group

Wheat Initiative: process of establishment of a new Expert Working Group

