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PHENOME: French Plant Phenomic Center

Francois F. Tardieu, Jacques Le Gouis, Pamela Lucas, Frédéric Baret, Pascal Neveu, Cyril Pommier, Nadine Hilgert, David Gouache, Xavier Pinochet

► **To cite this version:**

Francois F. Tardieu, Jacques Le Gouis, Pamela Lucas, Frédéric Baret, Pascal Neveu, et al.. PHE-
NOME: French Plant Phenomic Center. Recent progress in drought tolerance from genetics to mod-
elling, Jun 2015, Montpellier, France. 2015. hal-02744329

HAL Id: hal-02744329

<https://hal.inrae.fr/hal-02744329>

Submitted on 3 Jun 2020

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Interactive exhibit

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F. Tardieu¹, J LeGouis², P. Lucas³, F Baret⁴, P. Neveu⁵, C Pommier⁶, N Hilgert⁵, D Gouache⁷, X Pinochet⁸.

¹INRA LEPSE, Montpellier, ²INRA GDEC, Clermont Ferrand, ³INRA Transfert, ⁴INRA-Arvalis CAPTE, Avignon, ⁵INRA MISTEA, Montpellier, ⁶INRA URGI, Versailles, ⁷Arvalis, ⁸Cetiom

Climate change causes an increased frequency of unfavourable environmental scenarios with abiotic and biotic stresses, requiring the development of novel adapted varieties. Phenotyping is the major limitation for selecting genotypes in this context. *Phenome* (www.phenome-fppn.fr) develops a versatile, high-throughput infrastructure and a suite of methods allowing characterisation of hundreds of genotypes of different species under environmental scenarios of climate changes (e.g. drought, high CO₂ and high temperatures).

The infrastructure consists of (1) two platforms in controlled conditions (capacity of 1700 plants each) for in-depth analysis of leaf or root system architectures and growths under ranges of water deficits, CO₂ concentration and temperature; (2) two field platforms with semi-controlled environments, in particular large rainout-shelters and one free-air carbon enrichment (FACE) system (capacity 800 individual plots each); (3) three field platforms with higher throughputs (capacity 2000 individual plots each) equipped with soil and climate sensors. All platforms can cope with throughputs of 200-300 genotypes with the necessary number of repetitions and manipulate and/or control environmental conditions in order to impose well-characterised scenarios. Platforms are equipped with a consistent set of 3D functional imaging techniques, namely detailed imaging of roots and shoots in controlled conditions, canopy imaging with an autonomous 'phenomobile' that captures functional and 3D images of each plot, and drones that image hundreds of plots jointly. Two supporting platforms centralise metabolomic and structural measurements associated with phenotyping experiments. Platforms are accessible to public and private partners via the project website.

Applications with technological jumps are developed at infrastructure level, with partnerships with French SMEs. They (1) improve our capacity to measure plant traits at different resolutions in field and platforms (eg root and shoot architectures, light interception, transpiration rate) and environmental conditions (novel sensors); (2) organise phenotypic data originating from different platforms, so that they can be saved and analysed for a long period by a wide scientific community; (3) handle very large datasets with applications on data cleaning via artificial intelligence and analyses of time-related data; an interface with plant and crop models is developed. These methods and techniques are widely transferred towards the phenotyping community, academic and industrial. Phenome has already resulted in the development of SMEs aimed at phenotyping and/or precision agriculture (including one spin off, several patents and new activities of already existing SMEs. Networking and training activities are developed towards seed companies, SMEs and the extension system.

Phenome is part of an Infrastructure (I3) European project (EPPN) and is participating to an initiative for a preparatory phase for a European ESFRI infrastructure. It participates to the French national roadmap of Infrastructures with a widened partnership (CEA, CNRS, INRA).