RecoBar

NEWSLETTER ISSUE 2 – *2025*

The RecoBar project has reached its midpoint with very promising results. Preliminary findings from field experiments conducted under dryland conditions and low nitrogen soil concentrations ***(Figure 1)*** revealed remarkable yields (kg/ha) from certain landraces and old varieties.


Figure 1

The set of 29 barley NAM lines, carrying introgressions from three different exotic donors into the elite spring barley cultivar RGT-Planet, presented a three-week range of flowering dates between the earliest and the latest. Some of the NAM lines had yields comparable to modern varieties used as local checks.

Abiotic stress tests (drought, heat, and waterlogging) in greenhouses ***(Figure 2)*** and the field showed promising results. The genotypes tested displayed different responses to stress, and some of them stood out for their tolerance compared to others with greater susceptibility.

Promising populations have been obtained from crossing TILLING lines selected for increased culm diameter.

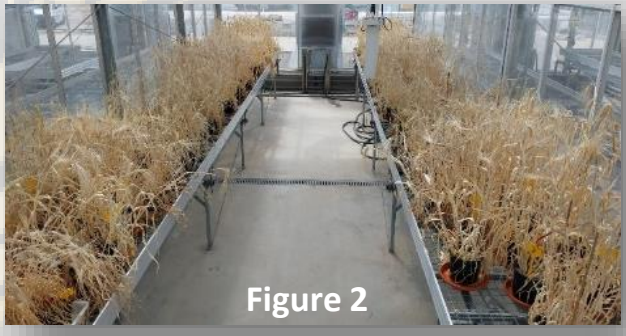


Figure 2

All of this genotypic and phenotypic information is being integrated using crop models that will allow us to develop a barley ideotype and predictive models to accelerate the genetic improvement of this crop, reducing the number of trials and field seasons needed to obtain robust conclusions about how a genotype responds to different environments.

This multidisciplinary project includes the analysis of the rhizosphere microbiota of six barley varieties, in five locations (Spain, Italy, Turkey, Finland, and Ireland) with standard and low nitrogen levels. The results prove the influence of genotypes on the diversity of microorganisms ***(Figures 3 and 4)***.


Figure 3


Figure 4

The second year of field trials is already underway in Italy, Turkey, and Spain. Trials will also continue under controlled conditions to study the response of different genotypes to abiotic stresses. All this will allow us to identify the most outstanding genotypes in terms of yield, flowering time, tolerance to abiotic stresses, and general agronomic value, as well as the lines developed with increased culm diameter, and genes with a critical implication in adaptation to abiotic stresses.

Preliminary Results of 2023-2024 season

WP1: Harnessing barley diversity to expand the crop genetic base for shifting agroecosystems

The results of the first RecoBar field trials conducted with low nitrogen, without additional fertilization, in dryland conditions in Spain, Turkey, and Ireland during 2023/24 season showed that some landraces attained yields comparable to some of the modern varieties in Spanish and Turkish field trials. In the Irish field trials, the old varieties had remarkable yields, comparable to some modern varieties, although lower than the local checks. Landraces and heritage varieties showed wide flowering dates, especially in Turkish and Spanish field trials.


Figure 5

The NAM lines showed a wide flowering range and, in some cases, comparable yields to modern control varieties.

This season, with the repetition of field trials already underway, we will obtain conclusions about how the old and local varieties behave in water and fertilization-limiting conditions and their potential in pre-breeding programs and for direct use ***(Figure 5)***. In addition, we hope to confirm the remarkable yields achieved by some of the NAM lines and determine the relationship of flowering time with yield in contrasting European environments.

WP2: Mining new traits and genes for tolerance to abiotic stresses

Experiments on the response to abiotic stresses, heat (EEAD-CSIC, Spain), drought (CREA, Italy; Univ. Tartu (Estonia); Univ. Silesia (Poland)) and waterlogging (UCD, Ireland), carried out under controlled conditions on 10 diverse varieties (minicore), show the potential of some of them in terms of tolerance to these stresses.

Heat stress experiments conducted in EEAD-CSIC had a major impact on fertility and grain yield reduction. Susceptible varieties were found, with reductions of up to 36% in the seed set, whereas other varieties showed more tolerance. Heat stress experiments in semi-controlled conditions (seedbeds) have been established in this season.

The minicore genotypes tested on the PlantArray of CREA (Italy) showed different daily transpiration patterns under drought conditions. A second drought stress experiment using the PlantArray lysimeters will be conducted on a smaller set of accessions in the spring of 2025 ***(Figure 6)***.


Figure 6

Drought stress experiments tested in early and late growth stages (Univ. Silesia in Katowice, Poland) indicated that, during the early-stage drought stress test, some varieties showed a robust recovery in photosynthetic capacity. In the late-stage drought stress test, one minicore variety did not decrease the chlorophyll and PIabs values.

Gas exchange measurements with VPD response (Univ. Tartu, Estonia) revealed variation of stomatal sensitivity across the varieties in both well-watered and drought conditions ***(Figure 7)***.

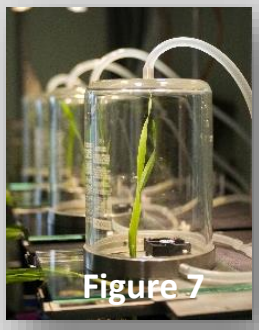


Figure 7


Figure 8

Waterlogging experiments carried out in UCD (Ireland) demonstrated the extremely negative effect on the average seed weight in all genotypes studied ***(Figure 8)***.

This set of experiments carried out on 10 diverse varieties has the potential to provide a catalogue of different responses and genes involved in tolerance to these abiotic stresses.

Preliminary Results of 2023-2024 season

Regarding the genetic and agronomic characterization of TILLING mutants for lodging resistance traits/candidate genes conducted in Univ. Milan (Italy), four segregating populations were obtained by crossing two TILLING lines selected for increased culm diameter with two different wild-type (WT) parents ***(Figure 9)***. For one of the TILLING mutants, mapping-by-sequencing, Whole Genome Sequencing (WGS), and bulks from one cross were conducted. The sequencing of the second cross is in progress. Both TILLING lines and wild-type (WT) Morex are being characterized under different N levels in the field. In addition, three alleles of potential interest were identified from screening TILLING mutants for one candidate gene for culm traits.

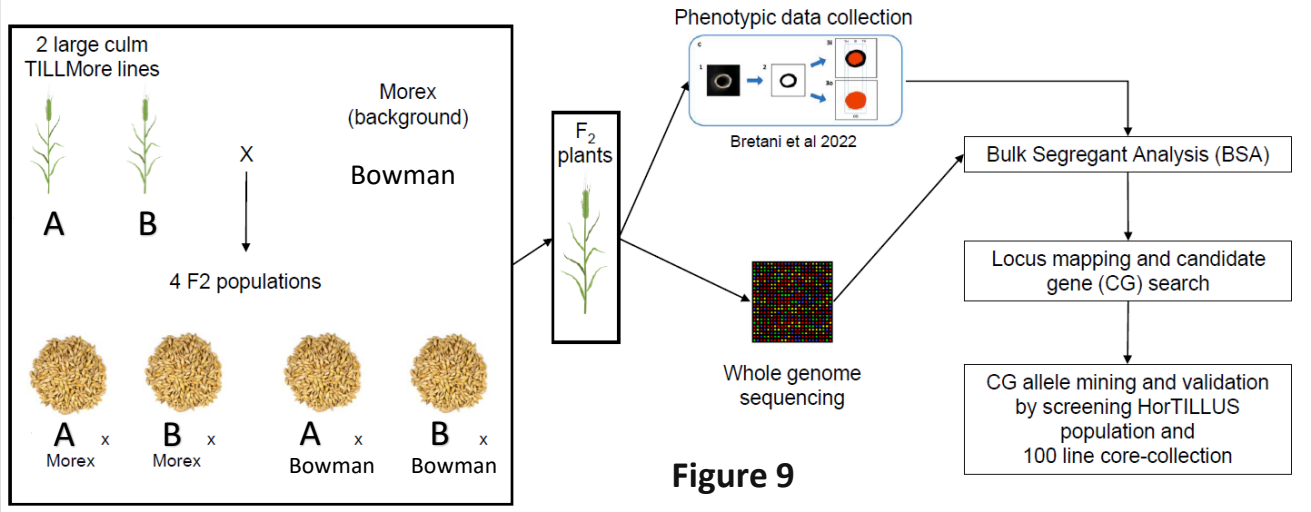


Figure 9

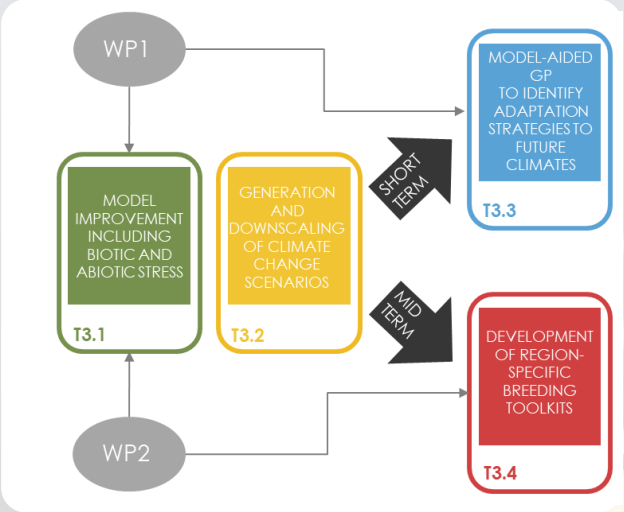
Four candidate genes were proposed by CREA (Italy) for allele-mining as potentially involved in drought stress response. Candidate genes with a possible involvement in barley response to abiotic stresses (in particular stomatal and drought-related traits) have been selected by all the partners. Allelic variation for these genes will be searched in the genomic data available or newly generated for the core barley accessions.

As part of allele mining efforts, RecoBar partners are involved in the WGS for 37 lines, old varieties and landraces from the core collection, without previous genomic information. These data are now ready for analysis.

Preliminary Results of 2023-2024 season

WP3 Results: Incorporating new diversity to barley ideotyping for future agroecosystems

T.3.1: A first version of the new hybrid model has been developed by using dedicated model libraries (Crop growth and development, Dynamics of availability of water and N, Abiotic and biotic stresses).



T.3.2: Uncertainty in future climate projections has been managed by using 104 climate scenarios. The analysis of future climates will be refined through agro-climatic indicators calculated on the barley season.

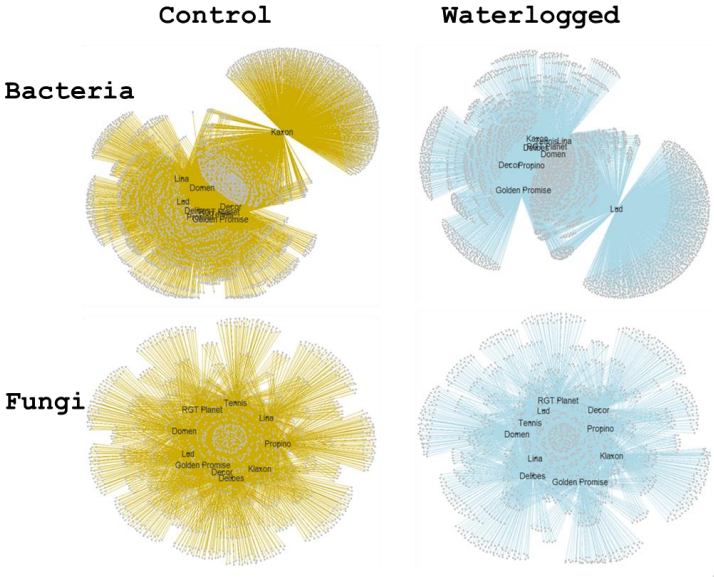
T.3.3: Model-aided genomic prediction will be implemented for short-term adaptation. Genomic prediction of heading date was extended to future climates through crop modeling, highlighting clear genotype-specific responses to climate change.

T.3.4: Breeding toolkits will be developed for medium-term adaptation. Preliminary region-specific ideotypes were defined by including germplasm-specific distributions of functional traits from field experiments (WP1). Preliminary results highlighted future yield benefits achievable with the ideotypes of up to 20%.

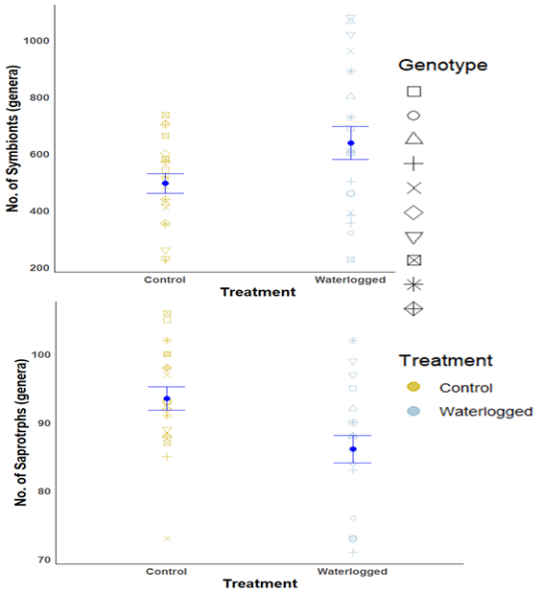
WP4 Results: Soil rhizosphere microbiota and response to stress

Waterlogging significantly altered microbial community composition

Plant-microbial networks showed high specialization with distinct genotype microbial communities that changed in response to waterlogging.



Symbionts were more abundant in waterlogging samples, and saprotrophs dominated under control conditions.



A second year of the trial to study the rhizosphere microbiome is underway in Italy and Spain. Data integration and modelling using the microbiome, AMF, and transcriptomic datasets are ongoing

Preliminary Results of 2023-2024 season

WP5: Communication and dissemination

✓ Articles published by the Recobar partners

Appiah, M. et al. 2023. Drought response of water conserving and non-conserving spring barley cultivars. Frontiers in Plant Science.
https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2023.1247853/full
Paul, M. et al. 2024. Precision phenotyping of a barley diversity set reveals distinct drought response strategies. Frontiers in Plant Science.
https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2024.1393991/full
Montardit-Tarda F. et al. 2024. New loci and candidate genes in spring two-rowed barley detected through meta-analysis of a European network of field trials.
https://www.biorxiv.org/content/10.1101/2024.09.04.611234v1

✓ Scientific events with the participation of Recobar partners

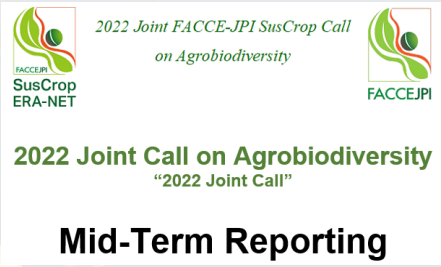
Igartua E., Caruso T. International Barley Hub Seminar: Towards sustainable barley production: The BESTCROP and RECOBAR initiatives. Online seminar 07/03/2024. https://barleyhub.org/ibh-seminar-best-crop-and-recobar/
Igartua E. GENVCE Innovation and Transfer Workshop (Jornadas de Innovación y Transferencia de GENVCE). Keynote talk**,** 28/05/2024. https://jornadasgenvce2024.es/#programa
Sancho R. Talk at Sixth Symposium on Physiology and Cereal Breeding **(VI SEFIMEC**). 16/10/2024**.** https://sefimec.org/program
Gipli, V.H. **Poster at LXVI SIGA** conference, 05-08/09/2023. ISBN: 978-88-944843-4-2
Rossini, L. **Talk** at the **Society of Experimental Biology 2024** conference. 02/07/2024-05/07/2024. https://www.sebiology.org/events/ems-past-event/seb-conference-prague-2024/programme.html
Gipli, V.H. **Poster** at **the LXVII SIGA conference**. 10/09/2024-13/09/2024. ISBN: 978-88-944843-5-9
Paleari., L., Talk at the **53rd conference of the Italian Society of Agronomy.** 11-13/09/2024.
Rossini, L. Talk at **the 14th International Barley Genetics Symposium Conference**, 28-31/10/2024. https://ibgs14.agro.uba.ar/?page_id=22
Tondelli, A. International Barley Hub seminars. Seminar 27/06/2024. https://barleyhub.org/ibh-seminar-barley-vs-abiotic-stresses-and-an-investigation-of-hvgrf4/
Tondelli, A. Talk at LXVII Annual Congress of the Italian Society of Agricultural Genetics (Bologna, Italy), 10-13/09/2024. ISBN: 978-88-944843-5-9
Guerra, D. Poster at LXVII Annual Congress of the Italian Society of Agricultural Genetics (Bologna, Italy), 10-13/09/2024. ISBN: 978-88-944843-5-9
Tondelli, A..Talk at the 14th INTERNATIONAL BARLEY GENETICS SYMPOSIUM (Rosario, Argentina), 28-31/10/2024. https://ibgs14.agro.uba.ar/?page_id=22
Śmietana M, Chmielewska B, Collin A, Szurman-Zubrzycka M, Daszkowska-Golec A, Janiak A. Talk at Young Scientists Conference. 24-25/10/2024.
Kollist, H. Talk at PlantEd conference. 18-20/09/2023.
Kollist, H. Keynote conference at European Congress on Biotechnology Conference 30/06/2024-03/07/2024. https://www.ecb2024.com/keynote-speakers
Caruso, T. Workshop. Network science and microbiomes: challenges and opportunities. 26-27/11/2024. https://ecologicalnetworks.imtlucca.it/
Igartua, I; Contreras-Moreira, B; Rossini, L; Rossi, Roberta. Four oral presentations on the Barley Genome Net 2025 conference

✓ More than 25 dissemination activities aimed at students (schools, institutes and universities) and the general public with talks and interviews on radio, TV and magazines.

Preliminary Results of 2023-2024 season

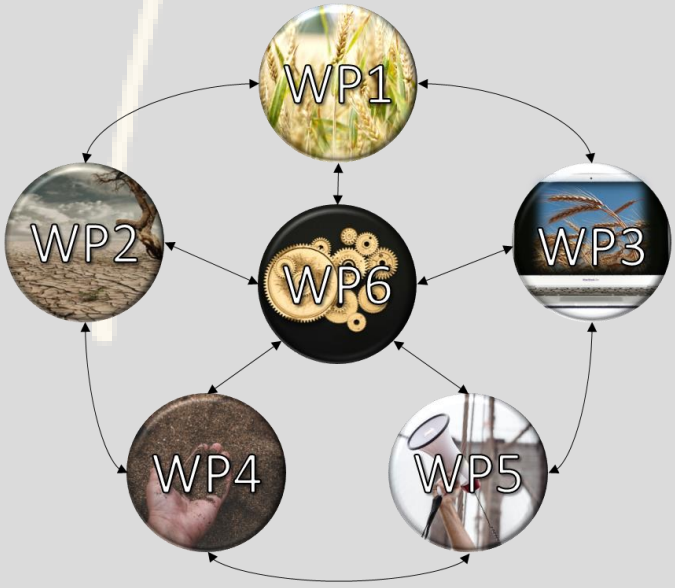
WP6: Coordination

- ✓ **Preparation and submission of the mid-term report of the 2022 Joint FACCE-JPI SusCrop Call on Agrobiodiversity.**



- ✓ **Organization of the 3rd annual progress meeting held in The International Barley Hub (Dundee, Scotland) on 3-4 February 2025.**

- ✓ **And much more …**
  - ❑ Seed distribution for next field trials
  - ❑ Experimental design
  - ❑ Tasks/WPs coordination



Stay up to date with all the results, tasks, and news from the RecoBar project on our website and social media!

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Grant PCI2022-135024-2 Funded by MCIN/AEI/10.13039/501100011033 and by European Union NextGenerationEU/PRTR.

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