

# FORAGES WG REPORT FOR PHASE X (2019-2023)

Submitted to the 17th Steering Committee Meeting, Oeiras, Portugal, May/June 2023  
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## 1. CONTRIBUTION TO ECPGR OBJECTIVES

### 1.1. Achievements and success stories

*1.1.1. To efficiently conserve and provide access to unique germplasm in Europe through AEGIS and the European Collection.*

A major effort in this regard has been made in the ECPGR Forage Working Group ImprovLoliumCol project with *Lolium perenne* (Table 1).

- i) Progress in the exhaustiveness of the European Forage Collection (EFC) for accessions from the natural diversity of perennial ryegrass. Accessions extensively documented in the GrassLandscape project are included in the EFC.
- ii) Progress in the documentation of EURISCO for C&E data is achieved from accessions representing the natural diversity of perennial ryegrass across Europe.
- iii) Additional environmental descriptors of sites of origin of accessions from the natural diversity of perennial ryegrass were first accessible via crop portals and linked with EURISCO.
- iv) Two levels of the core collection for accessions are set from the natural diversity of perennial ryegrass first accessible via crop portals and possibly later through EURISCO.

Table 1. Contributions of ECPGR genebanks to the set of accessions (*L. perenne* and related taxa) used in the *GrassLandscape* project, progress in registration in EURISCO and in flagging as AEGIS and contributions of genebanks to the two levels of core collection set up by the Activity. (Taken from the final report of the ImprovLoliumCol project).

Instcode	Number of accessions							
	<i>GrassLandscape</i>	<i>GrassLandscape</i> with C&E data	EURISCO at start of Activity	EURISCO at end of Activity	AEGIS at start of Activity	AEGIS at end of Activity	Large core collection <sup>d</sup>	Small core collection <sup>d</sup>
AUT060	1	1	0	1 <sup>e</sup>	0	1 <sup>e</sup>	1	1
BEL094	7	7	5	7	0	2 + 1 <sup>e</sup>	2	1
CHE002	6	6	5	5	0	5 <sup>e</sup>	3	2
CZE082	11	9	0	11	0	10	6	5
DEU271	183 (9)	183 (9)	183	183	160	183	87	68
DEU271 (GRIN)	22	0	0	22	0	22 <sup>c</sup>	0	0
EST019	5	4	1	5	1	5	2	1

FRA001	83	83	0	83	0	83 <sup>e</sup>	44	33
GBR016	86 (1)	79 (1)	86	86	0	0	51	38
ITA394	6	6	5	5	0	5	4	4
LTU001	9	9	0	9	0	9	5	2
NLD037	8	6	8	8	8	8	4	2
SRB000	1	1	0	1 <sup>e</sup>	0	1 <sup>e</sup>	1	1
SVN019	2 (1)	2 (1)	0	1	0	1	1	1
SWE054	8	0	8	8	2	8	0	0
<b>Total</b>	<b>438 (11)</b>	<b>396 (11)</b>	<b>301</b>	<b>435</b>	<b>171</b>	<b>344</b>	<b>211</b>	<b>159</b>

DEU271, GBR016 and SVN019 provided some accessions for taxa related to *L. perenne*. For these three genebanks, the columns 'GrassLandscape' and 'GrassLandscape with C&E data' display the total number of accessions provided (*L. perenne* + related taxa) followed by the number of accessions from taxa related to *L. perenne* in brackets. All the other genebanks provided only *L. perenne* accessions.

<sup>e</sup> Number of accessions expected, but not confirmed, to be soon flagged as AEGIS (and registered in EURISCO for AUT060 and SRB000).

<sup>c</sup> Number of accessions confirmed to be soon flagged as AEGIS.

<sup>d</sup> The large and small core collections have been selected by sampling accessions in each of the 17 clusters of a cross partition between a genomic partition based on 507 583 SNP loci and a phenotypic partition based on traits recorded in three trial locations with contrasted climatic conditions.

Progress regarding AEGIS has also been made in individual genebanks during phase X. The change since 2015 and 2018 can be seen in Table 2.

**Table 2.** Forage accessions in EURISCO and the numbers flagged as AEGIS

Country	Total in EURISCO 22/3 2023*	AEGIS accessions 1/11 2015	AEGIS accessions 16/2 2018	AEGIS accessions 22/3 2023
Belgium	246			2
Czech Rep.	4,059	236	291	423
Germany	14,527	2,203	8,044	7,991
Estonia	263	0	53	59
UK	17,445	2,431	0 <sup>#</sup>	0
Italy	5,959			759
Lithuania	597			9
Nordic countries	5,406	1,303	1,303	2,171
Netherlands	1,035	851	851	849
Slovenia	649			2
<b>TOTAL</b>		<b>7,024</b>	<b>10,542</b>	<b>12,265</b>

\*Includes the genera: *Agrostis*, *Alopecurus*, *Arrhenatherum*, *Bromus*, *Dactylis*, *Festuca*, *Lolium*, *Lotus*, *Medicago*, *Phalaris*, *Phleum*, *Poa*, *Trifolium*. Only countries with AEGIS accessions included in the table.

<sup>#</sup>Unflagged due to administrative issues

1.1.2. To provide passport and phenotypic information of actively conserved European PGRFA diversity *ex situ* and *in situ* through the EURISCO catalogue.

For this objective, two major activities have been carried out.

Activity 1: The crop portal of forages: <https://eurisco.ipk-gatersleben.de/apex/weise/r/forage/home>

has been implemented as a cooperation between the Data Documentation and the Forages working group. This portal provides information about various forage crop collections maintained *ex situ* in Europe. The 147,698 accessions from 14 genera are conserved in genebanks (105 institutions in 36 countries) throughout Europe.

Activity 2: Aspects of the EUCLEG project dealt with improving data availability in EURISCO.

This project has improved the data availability in EURISCO on soy bean, alfalfa, pea, red clover and fava bean. Three additional institutions added alfalfa and red clover data to EURISCO between 2018 and 2021 and, in total, 1,608 new accessions of these species were added, bringing the data for these two species from 17,310 as starting point up to 18,918 accessions. For red clover, the Nordic Genetic Resource Centre/Sweden added 5,441 C&E records to EURISCO.

**Table 3.** Number of accessions available in EURISCO for *Medicago sativa* and *Trifolium pratense* in March 2018 and 2021 (data extracted from Table 4, Deliverable 2.1 of EUCLEG EU project<sup>1</sup>).

Species	No of acc. <sup>1</sup> 2018	No of inst. <sup>2</sup> 2018	No of acc. <sup>1</sup> 2021	No of inst. <sup>2</sup> 2021	Change in no of acc.	Change in no of inst.
Alfalfa ( <i>Medicago sativa</i> )	7,847	47	8,463	49	616	2
Red clover ( <i>Trifolium pratense</i> )	9,463	48	10,455	49	992	1

<sup>1</sup>No of acc.= number of accessions registered in EURISCO

<sup>2</sup>No of inst.= number of institutions where the accessions registered in EURISCO are stored.

<sup>1</sup> <http://www.eucleg.eu/index.php/outputs/deliverables>

**Table 4.** Forage C&E records in EURISCO in 2018 and 2023

Forage genus	C&E EURISCO 2018*	C&E EURISCO 2023#
Agrostis	180	2,132
Alopecurus		518
Arrhenatherum		1,979
Bromus		588
Dactylis		3,308
Festuca		14,152
Lolium	28,428	76,306
Lotus		1,494
Medicago		30,384
Phalaris		291
Phleum	186	30,868
Poa	6,611	11,209
Trifolium	292	28,325
<b>Sum.</b>	<b>35,697</b>	<b>201,554</b>

\*No. of C&E records/data points in EURISCO 2018-02-16; # No. of C&E records/data points in EURISCO 2023-03-22

### 1.1.3. To improve *in situ* conservation and use of crop wild relatives

Several Forages working group members participated in the EU project Farmer's Pride which planned *in situ* conservation strategies, see below.

## 1.2. Gaps or constraints identified

-Within the EU project EUCLEG questionnaires were sent out to genetic resource collection holders and project partners, and a gap analysis was carried out comparing the European Central Crop Data Bases and EURISCO. From the results of the questionnaire, it is clear that many institutes have C&E data of red clover and alfalfa that have not been uploaded to EURISCO. There are also some conserved accessions for which passport data is not available in EURISCO. There is a need to encourage the upload of C&E data on EURISCO and to a lesser extent basic information on conserved accessions.

-A severe constraint for the working group that has taken its toll after several years is the lack of funding for meetings with the entire forage working group in person. This is hampering the exchange of ideas, discussion and exchange of knowledge.

-A lack of flagging AEGIS accessions is also a constraint.

- A major constraint is the lack of national and EU funding for the regeneration of existing *ex situ* collections. There is insufficient knowledge of the numbers of accessions per species which are in urgent need of regeneration. A comprehensive survey on regeneration needs calls for urgent action.

## 2. GRANT SCHEME ACTIVITIES, WG MEETINGS AND EVA ACTIVITIES

- **Grant Scheme proposals (submitted:0; approved:0)**  
Due to the pandemic, the [ImprovLoliumCol](#) Activity, approved in Phase IX, was extended until the end of April 2022
- **Total number of partners involved: n/a 9 (different partners)**
  - ECPGR-funded: n/a partly, for 2 meetings (INRAe Paris, IPK Gatersleben)
  - Self-funded: n/a
- **Meetings held**  
ImprovLoliumCol
  - First meeting, 6-8 December 2018, Paris, France
  - Mid-term meeting and data training workshop, 17 September 2019, IPK Gatersleben, Germany
- **Reports and related data**
  - [ImprovLoliumCol Final Activity Report](#) (2022)
  - Archive databases for [Minor Forage Grasses](#) and [Phleum](#)
  - Webinar presented by J.P. Sampoux: Facilitating the use of the European perennial ryegrass collection – The experience of the ECPGR ImprovLoliumCol project (February 2023)
- **Funds mobilized**
  - ECPGR granted funds: n/a
  - Inputs in-kind declared in Grant activities: n/a

## 3. OTHER ACTIVITIES (CROSS-WORKING GROUP ACTIVITIES, LINKS WITH OTHER NETWORKS, INTERNATIONAL PROJECTS AND INITIATIVES)

- **Cross-Working Group activities:**  
A cross working group initiative was the crop portal of forages: <https://eurisco.ipk-gatersleben.de/apex/weise/r/forage/home> between the Documentation and Information Working Group and the Forages Working Group. This was facilitated by Stephan Weise in his double role as EURISCO coordinator and member of the Documentation and Information Working Group.

- **Others:**

Several Forages Working Group members participated in the EU project **Farmer's Pride** (2017–2021). The project's main objective was to establish a network of stakeholders and conservation sites that effectively coordinates conservation actions to safeguard Europe's *in situ* plant genetic resources (PGR) and integrates the user community to maximize their sustainable use.

Two **Nordic projects on CWR** led by Anna Palmé links to activities of the Forage Working group ('Nordic Crop Wild Relative network – conservation for a more resilient Nordic agriculture' 2020–2022 and 'Conservation and sustainable use of genetic

resources in the Nordic countries' 2021–2024). The main goal of these projects is improved conservation of CWR, including forage CWR, in the Nordic region and the latter project includes collection of CWR for *ex situ* conservation and inventory of CWR conserved *in situ*.

**NordGen's Forage Working Group.** A Nordic working group on forages with members from all the five Nordic countries, some of which are also members of the ECPGR Forages WG.

#### 4. WORKING GROUP DOCUMENTS AND PUBLICATIONS

Whilst there are no official publications from the Working Group for Phase X several relevant publications also linking to the ImprovLoliumCol project which was leveraged on the basis of the FACCE Era-Net GrassLandscape project can be noted:

- Blanco-Pastor, J. L., Manel, S., Barre, P., Roschanski, A. M., Willner, E., Dehmer, K. J., Hegarty, M., Muylle, H., Ruttink, T., Roldán- Ruiz, I., Ledauphin, T., Escobar-Gutiérrez, A., Sampoux, J.-P. (2019). Pleistocene climate changes, and not agricultural spread, accounts for range expansion and admixture in the dominant grassland species *Lolium perenne* L. *Journal of Biogeography* (46), 1451-1465. , doi: 10.1111/jbi.13587
- Blanco-Pastor, J.L., Barre, P., Keep, T., Ledauphin, T., Escobar-Gutiérrez, A., Roschanski, A.M., Willner, E., Dehmer, K. J., Hegarty, M., Muylle, H., Veeckman, E., Vandepoele, K., Ruttink, T., Roldán-Ruiz, I. Manel, S., Sampoux, J. P. (2021) Canonical correlations reveal adaptive loci and phenotypic responses to climate in perennial ryegrass. *Molecular Ecology Resources*, 21, 849–870, doi: 10.1111/1755-0998.13289
- Borra-Serrano I., De Swaef T, Muylle H, Nuyttens D., Vangeyte J., Mertens K., Sayes W., Somers B., Rodan-Ruiz I., Lootens P. (2019) Canopy height measurements and non- destructive biomass estimation of *Lolium perenne* swards using UAV imagery. *Grass Forage Sci.* 2019;00:1–14. <https://doi.org/10.1111/gfs.12439>
- Keep, T., Sampoux, J. P., Blanco-Pastor, J. L., Dehmer, K. J., Hegarty, M. J., Ledauphin, T., Litrico, I., Muylle, H., Roldán-Ruiz, I., Roschanski, A. M., Ruttink, T., Surault, F., Willner, E., Barre, P. (2020). High-throughput genome-wide genotyping to optimize the use of natural genetic resources in the grassland species perennial ryegrass (*Lolium perenne* L.). *Genes|Genomes|Genetics*, doi:10.1534/g3.120.401491
- Keep, T., Sampoux, J.P., Barre, P.; Blanco-Pastor, J.L., Dehmer, K., Durand, J.L., Hegarty, M., Ledauphin, T., Muylle, H., Roldan-Ruiz, I., Ruttink, T., Surault, F., Willner, E., Volaire, F. (2021a) To grow or survive: which are the strategies of a perennial grass to face severe seasonal stress? *Functional Ecology*, 35, 1145–1158, doi: 10.1111/1365-2435.13770
- Keep T., Rouet S., Blanco-Pastor J.L., Barre P., Ruttink T., Dehmer K.J., Hegarty M., Ledauphin T., Litrico I., Muylle H., Roldán-Ruiz I., Surault F., Veron R., Willner E., Sampoux J.P. (2021b). Inter-annual and spatial climatic variability have led to a balance between local fluctuating selection and wide-range directional selection in a perennial grass species. *Annals of Botany*, 128, 357–369, doi: 10.1093/aob/mcab057
- Nay MM, Grieder C, Frey LA, Amdahl H, Radovic J, Jaluvka L, Palmé A, Skøt L, Ruttink T, Kölliker R (2023) Multi-location trials and population-based genotyping reveal high

diversity and adaptation to breeding environments in a large collection of red clover. *Frontiers in Plant Science* 14. DOI=10.3389/fpls.2023.1128823  
Zanotto S, Palmé A, Helgadóttir Á, Daugstad K, Isolahti M, Öhlund L, Marum P, Ahlin Moen M, Veteläinen M, Rognli OA, Ergon Å (2021) Trait characterization of genetic resources reveals useful variation for the improvement of cultivated Nordic red clover. *Journal of Agronomy and Crop Science*. doi.org/10.1111/jac.12487

## **5. EXPECTED ADDITIONAL ACHIEVEMENTS AND FUTURE ACTIVITIES THAT COULD CONTRIBUTE TO THE IMPLEMENTATION OF THE PGR STRATEGY FOR EUROPE**

The Forages working group could advertise PGR stronger in the EUCARPIA Forage and Turf section. It is envisaged to present a poster on Forage PGR collections at the Eucarpia Forage section meeting in September 2023 in Brno/Czech Republic.

Currently, there is no EVA network for the Forages Working Group. However, its establishment should be considered for at least one of the forage species like *Lolium perenne*, *Phleum pratense*, *Trifolium pratense*, *Dactylis glomerata*, or *Festuca arundinacea*. It needs to be discussed which of these species would have a major widespread European interest with regard to climate change and forage production. Also, decisions would need to be made on a common descriptor list for an EVA Forage Working Group activity. An EVA project could also be the progenitor of a project like GrassLandscape.

A networking group on cultivation and regeneration across Forages and other related species groups, like Crop Wild Relatives should be considered for future activities.