ECPGR Activity Grant Scheme Proposal Form

Fifth Call – Phase X (2019-2023)

Activity Proposal

Activity	
Full title	Chances for the conservation and re-cultivation of central european club wheat (Binkel) through a nutritional and genetic differentiation towards other wheat species
Acronym (or short title)	BiDifferent
Duration of Activity (in months)	24
Start date – End date *Please indicate start date not earlier than 3 months after deadline of Call*	January 2022 – December 2023

Applying Working Group(s)

	Working Group	Indicate name and surname of Working Group Chair
1.	On-farm Conservation and Management	Prof. Valeria Negri
2.	Wheat	Dr. Albrecht Serfling

Activity Coordinator

Activity Coordinator	
Name and Surname	Voegel Rudolf
Working Group	On-farm Conservation and Management
Nationality	german
Current position	Senior officer
Institute	VERN e.V. (Association for conservation and recultivation of crops)
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Activity Partners (ECPGR-funded)

Please note that each partner needs to be a member of an ECPGR Working Group to be eligible for funding. For self-funded partners please use the separate box below.

Partner ID No.	Name and Surname	Institute	Country
1	Rudolf Vögel	VERN	Germany
2	Christian Partl	Genbank Tirol	Austria
3	Albrecht Serfling	Julius Kühn-Institut Quedlinburg, Germany	Germany
4	Manuel Pramsohler	Laimburg Research Centre	Italy
5	Clement Debiton	INRA France	France
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Self-funded partners

Partner No.	Name and Surname	Institute	Country
1	Klaus Fleißner, Ulla Konradl	Bayerische Landesanstalt für Landwirtschaft (LfL)	Germany
2	Jan Gabathuler u. Koll.	Plantahof, Graubünden	Suisse
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Description of Activity (suggested max. 1000 words)

Please address the following aspects:

– *Background:* Explain the context behind the choice of this Activity, e.g. why this has been prioritized or selected. If this is the continuation of a preceding Activity, please indicate how and why the new Activity will build on previous results/experiences.

The spread of club wheat (*Triticum aestivum* subsp. *compactum*; in the context of this proposal we talk about "Binkel") in Europe (especially in the Alpine region) is documented to have taken place thousands of years ago, at about the same time as common wheat and spelt. Cultivation extended into the 20th century in the regions of northern Tyrol, southern Germany, northern Italy, France and Switzerland. It seems Club wheat has been a special adapted wheat subspecies to mountain regions, often with cultivation in mixtures. Gradually, the small-grain Binkel was displaced by the higher-yielding types of common wheat and spelt in the 19. century, but it was able to survive sporadically in Europe in mountainous regions until the 20th century because of its special properties (therefore also called mountain wheat). There are documents for Austria, Swiss and Germany given from SCHILPEROORD and MAYR.

"Echter Binkelweizen" (*Triticum aestivum* subsp. *compactum*; real club wheat) has been admitted as a passenger into the "Slowfood arch of taste" in early 2021. Simultaneously, different landraces of Binkel- and Igelweizen (awned club wheat) have been cultivated during 2021 at locations in Germany and Austria in a 12-month EURegio InterReg project with the objective to assess the feasibility for the on-farm conservation and re-cultivation of Binkel in alpine agriculture through a collection of relevant agronomic and qualitative data. The seed material for the project was taken from the Austrian and German gene banks and a local stock of the Bavarian State Research Institute for Agriculture (LfL). At a field day on 1st July 2021, where mature plants could be examined in the field, the question came up, if all accessions that have been cultivated can be classified as "Echter Binkelweizen" or if some of them only are just morphologically similar but genetically do not fall under this specification.

– *Justification:* Explain why this Activity is justified in terms of making progress towards achieving the ECPGR objectives.

To delimit the "Echter Binkelweizen" varieties from other bread/common wheat landraces a genetic analysis needs to be carried out from the harvested material combined with a phenotype description. There is a dominant allele on the C (compactum) locus on chromosome 2D, which is responsible for the characteristic ear morphology of club wheat. It is a mutation that developed spontaneously in *T. aestivum* over time. Since there are molecular markers for the C allele, it would easily be possible to detect "Echter Binkelweizen" (the *compactum* subspecies) using molecular biology. This "proof of identity" would help marketing efforts and recultivation to farms under the "Slowfood" label. However, it is not clear, which genetic mechanism in the background is responsible for the compactum phenotype. Furthermore, outside of the current region of cultivation, no data of its suitability for cultivation, especially with regard to disease resistance and tolerance to abiotic stress situations exist.

The agronomic experiments in 2021 were affected by extreme weather conditions (storm rains, hail, strong wind gusts), which caused heavy lodging and probably outgrowth. Therefore, the data from 2021 will not be resilient enough for valuable conclusions and more agronomic data and ingredient analysis will be needed.
ECPGR-objective 4.4 - Definition of Most Appropriate Areas MAPAs sites of on-farm cultivated plant diversity discussed and implemented: it is important to find out where Binkel can be grown best (soil and climatic circumstances) and to verify some historic documents in which the cultivation of Binkel is described, because there are interesting historic sources about outstanding resistance, tolerance against diseases (rust, tilletia) and stress adaptation. (MAYR, SCHILPEROORD, KWICH).

A qualitative analysis of the corn ingredients (main components, nutritionally beneficial ingredients, …) is needed to select the most appropriate accessions for further studies (e.g., suitability for bakery products), so that it can be shown that the Binkel landraces can be very interesting for farmers, millers and bakeries.
ECPGR-objective 4.4.1 - Through dedicated meetings of interested country representatives, promoting agreement on criteria for definition of MAPAs containing unique landrace populations: to ensure the on-farm conservation of this almost extinct wheat sub-species in the alpine region, the project partners in Austria, Italy, France, Switzerland and Germany will cultivate different Binkel landraces on-farm to assess their adaptation and suitability to specific agro-ecological environments. Suitability for a successful cultivation furthermore depends on resistance/ tolerance to biotic stress (e.g. fungal pathogens) or abiotic stress (e.g. frost tolerance, dry stress tolerance).

Binkel accessions are not well described in the existing collections. There is a lack of publications and knowledge about Binkel in history and present age.
Because of the lack of documentation genetic characterisation and clear separation to other wheat ssp. is also unknown.
Nevertheless, club wheat is an example of a non-interrupted cultivation history in a region of special bioclimatic conditions and an adapted small-scale agriculture.
Clearing of genetic neighbourhood, scoping for resistance/tolerance and potential use for modern breeding, also promoting cultivation and processing as an outstanding regional product are the main tasks of the work.

– *Rationale for the choice of partners:* Explain why the selected partners are the most suitable to carry out the proposed Activity and briefly describe their respective roles in the Activity.

LfL Bavaria and Genbank Tirol have been working together in the InterReg project and have concluded that for the re-cultivation of Binkel further research is needed, especially to determine the genetical affiliation of the accessions to the genetic pool of Binkel landraces and to obtain more reliable data. The Laimburg Research Centre in norther Italy also has good knowledge in the cultivation of special wheat accessions and all institutions that will be partners in the project will conduct the relevant experience. INRA from France will provide an additional collection of club wheat accessions for phenotype description, field trial and genetic analysis. Furthermore additional accessions from Suisse national collection (Agroscope) will be evaluated.
The Suisse scientists have a considerable knowledge of alpine cereals (P. Schilperoord, Plantahof) and are offering to share the experience in the project.
For years now, VERN (Verein zur Erhaltung und Rekultivierung von Nutzpflanzen = Association for the preservation and recultivation of crops) is conserving several Binkel landracesin its conservation assortment and VERN has a wide network of member farmers, covering whole Germany. (4.4.2 On-farm conservation and management WG with appropriate national stakeholders and authorities).
The Julius Kühn-Institut, Institute for Resistance Research and Stress Tolerance, Quedlinburg has a long time experience in evaluation of plant genetic resources, cultivation and multiplication of pathogens for experiments, field trials and simulation of abiotic and biotic stress situations (e.g. by inoculation of pathogens) especially of wheat.

– *Methodology or Approach:* Explain how the partners will operate. Clearly explain who is expected to do what. Also explain the rationale of meeting (or not) as part of the Activity. Include a Grant Chart, to illustrate the work breakdown structure of the project.

The results obtained in 2021 (especially concerning the growth parameters and quality of corn) need to be verified by repeating and expanding the cultivation of the accessions. Therefore, the accessions will be grown again at the respective sites of the different partners (Genbank Tirol, Laimburg Research Centre, LfL and, especially for processing use also at VERN in northern germany) that are involved in this project. INRA will take also club wheat accessions from hold collection for phenotype description, and field trials in 2023.
ECPGR-objective 4.3 – Good practices for on-farm management and conservation and adding value

promoted: in order to get more valuable and comparable data concerning growth and harvest, the experience will be repeated with the same *T. aestivum* subsp. *compactum* accessions and some common *T. aestivum* land races for comparison at all sites in the years 2022 and 2023.
The upgrowth will be controlled and documented relevant growth and post-harvest data, as well as potentially phytopathogenic resistances (to insects or fungi).
ECPGR-objective 4.5 – obstacles to on-farm conservation and management analysed and solutions proposed: thereby it can also be monitored if there are regions that are more favourable to the growth of *T. aestivum* subsp. *compactum* and recommendations for the cultivation farming can be given to interested farmers, millers and other fabricators.
ECPGR-objective 4.4.1 – through dedicated meetings of interested country representatives, promoting agreement on criteria for definition of MAPAs containing unique landrace populations: the partners in the project will be in frequent exchange (in online-meetings and for field visitations in each summer at a different site) in order to share and compare their mutual experience in the cultivation of the club wheat accessions.
Samples from the 2022 experiments will be send for genetic analysis to an external service provider (to be determined by a call for tenders) under charge of JKI. As Binkel landraces are probably heterogeneous populations, more than 1 sample per cultivar need to be analysed to cover the span of genetic heterogenity.

Members of VERN will be part of a participatory variety selection process, which will be conducted annually at the project sites.
ECPGR-objective 4.4.2/3 – On-farm conservation and management WG with appropriate national stakeholders and authorities: the project partners will meet at each site to exchange experiences and compare notes concerning the maintenance of the landraces.
ECPGR-objective 4.3.1 – provision of store of knowledge and evidence-based practices, related to successful experiences of conservation and sustainable use of landraces and other heterogeneous genetic resources in Europe: baking quality and relevant qualitative data will be determined by a suitable laboratory (external service provider, to be determined by a call for tenders) offered internal by VERN. A call will be made to bakers and 3 – 5 suitable and interested ones will be selected for test baking. Therefore, in greenhouse and field experiments resistance against rusts, powdery mildew, Fusarium. Zymoseptoria tritici and Tilletia with selected genotypes (based on typical Binkelweizen phenotype) are intended at JKI. The ten most resistant genotypes against both diseases will be selected and tested for their dry stress tolerance using a Plant-Array. Using this approach, maximum water holding capacity will be set to 70% and to 10 percent over a period of three month after the germination.

– Description of genetic material: If your Activity is focusing on genetic material, please describe in detail, as far as possible, who is providing this genetic material, its status and the number of accessions under investigation (for example: *This Activity aims at molecularly analysing / safety-duplicating / evaluating / collecting XY accessions (listed) of "Genus species", provided by genebank Z/ farmers in country W /to be collected in country P…, etc.*).

The genetic material of approximately 22 Binkel- and Igelweizen (*T. aestivum* subsp. *compactum*) landraces will be provided by the Genbank Tirol, the LfL and VERN. It is part of a field collection of Binkel. A minimum of 20 selected common *T. aestivum* landraces from the Bavarian and Austrian gene pool will be added as checks to undergo molecularly analysing. They will be genetically analysed to distinguish whether the chosen accessions can be counted to the separate subspecies club wheat (*Triticum aestivum* subsp. *compactum* ; "Binkel") or belong genetically to the common wheat pool.
Selection and choosing expected 20 samples for detailed genetic characterisation (SNP-markers-techn.) will result from field description and phenotype evaluation 2022. Additionally, from the offered collection of Agroscope, Suisse and INRA, France about 23 accessions, selected for middle European origin will be kept also under detailed genetic description.

– *Expected impact.* Clearly specify the expected impact from this Activity for the respective ECPGR objective(s), compared to the current state of progress of those same objectives. Explain how the impact will be obtained.

The expected impact of the activity is to determine which landraces under investigation in this project belong to the "Echter Binkelweizen" (*Triticum aestivum* subsp. *compactum*) gene pool. There are accessions that phenotypically look like Binkel but are currently counted to the common wheat (e.g., TRI 3724, "Obermenzing"). In this project it needs to be verified if these accessions belong to the "Echter Binkelweizen" gene pool.
ECPGR-objective 5.2 - Facilitated use and consumption of crop species and varieties or landraces by consumers: the on-farm and in-situ conservation of Binkel accessions will be assured and even expanded through the qualitative analysis of the ingredients and bakery qualities, which will encourage local stakeholders (farmers, millers, bakers) to re-introduce Binkel in their processes. Together with the listing of Binkel in the "Slowfood arch of taste" the interest in Binkel-products will find attention by a larger number of consumers.
ECPGR-objective 4.4 - definition of most appropriate areas (MAPAs) sites of on-farm cultivated plant diversity discussed and implemented: As the Binkel-landraces are grown and monitored at different sites in the alpine and subalpine region, at the LfL Lower Bavaria, Laimburg, South Tyrol, Innsbruck, Northern Tyrol, INRA, mountain region of southern France and at JKI field station and VERN-site(Quedlinburg Brandenburg, Germany), it can be found out, in which country/region the climatic and soil conditions are most favourable for the future cultivation of club wheat. Resistant genotypes with resistance against different fungal diseases and to abiotic stress situations will be selected, so that the region of cultivation can be extended for club wheat.

– *Links with other non-ECPGR projects or individuals*: If applicable, clearly explain the objectives of the linked projects and the reasons for complementarity with the ECPGR Activity.

As mentioned above, the EURegio InterReg-project "Urgetreide Binkel – Chancen für die Rekultivierung einer historischen Getreideart des Voralpen- und Alpenraumes" in 2021 was a common project of the LfL, Genbank Tirol and other partners in which the cooperation and the interest to research together on Binkel was founded. During this project many new questions came up (genetic analysis in order to see which accession belong to the "Echter Binkelweizen" pool and which ones are common wheat varieties. As growing conditions in 2021 were very unfavourable, the previously involved project partner would like to continue with the work and to grow the accessions again to be able to undertake additional necessary and relevant analysis to be able to come to relevant conclusions.
In addition, research partners from Italy (Laimburg Research Centre) and Switzerland could be allured, also INRA, France gave interest of offers accessions and field trials so that many partners of different countries in the alpine region are involved in the project.
Julius Kühn-Institut, Institute for Resistance Research and Stress Tolerance evaluates regularly more than 100 genotypes of wheat genetic resources in frame of the ECPGR evaluation program and the national evaluation program EVA2. Evaluation included some club wheat accessions in the past already. JKI is specialised in the rating of resistance to biotic and abiotic stress and participates or coordinates different projects dealing with genetic resources of wheat and host-pathogen interaction.
Actual there are no further projects, running activities known with club wheat. Also there are no publications and specific literature about club wheat available.

Expected products and related ECPGR Objectives

List concrete products and results that are obtained by the Activity and the corresponding number(s) of the ECPGR Outcome(s) and/or Output(s) and/or Activities to which each product/result will contribute.

	Expected products/results	Corresponding ECPGR output, activity
1	Comparison of plant growth parameters in four different countries (Germany, Italy, Austria, France)	1.3 European Accessions properly maintained
	Determine the most favourable regions and conditions for the growth of *T. aestivum* subsp. *compactum* (to give recommendations to interested farmers, millers and other fabricators)	ECPGR-objective 4.5 – obstacles to on-farm conservation and management analysed and solutions proposed
2	Evaluation of modern behaviour of club wheat (yielding, performance, resistence/tolerance to biotic and biotic stress) suitability for renewing use in alpine agriculture and collecting data about historic use and cultivation area	ECPGR-objective 4.4.1 – through dedicated meetings of interested country representatives, promoting agreement on criteria for definition of MAPAs containing unique landrace populations
3	Knowledge about agronomic (weather, soil, pathogens…) and qualitative properties (substances of content), qualification of Binkel for bakery products	ECPGR-objective 4.3.1 provision of store of knowledge and evidence-based practices, related to successful experiences of conservation and sustainable use of landraces and other heterogeneous genetic resources in Europe
4	Quality testing and processing technics for consumers products; Reguiding of bulk wheat for market, bakers Promoting further activities for the recultivation of regional crops in alpine and pre-alpine areas	

Workplan for the proposed period of the Activity

Brief description of meetings and/or main actions of the Activity.

	Type of Action *(indicate if "meeting" or "other action")*

1	Meeting: Start up meeting 3/2022, midterm meeting 2/2023, results workshop an final meeting 2024
2	Other action: Genetic descriptions and gen bank-samples evaluation
3	Other action: Processing quality evaluation and product testing
4	Other action: On farm research - guided field trials and on farm-experiments with farmers
5	Other action: Testing and evaluation about resistances against common wheat pathogens and tolerance to abiotic stress (laboratory and plot screening)
6	Other action: Sceening and documentation of gene-bank collections, AEGIS-inventory… for Trit. Aest. Compactum samples (including existing passport data)

Additional remarks

Indicate any additional remark(s) that is/are important for the evaluation/implementation of the proposed Activity

Remarks:

Please send the completed form together with the budget table to the Chair of the submitting Working Group for submission of the Activity proposal.