Summary report
of the

Annual meeting of the
European Evaluation Network (EVA) for Maize

28-29 November 2023
Montpellier, France

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The EVA Maize annual project meeting took place on 28-29 November in Montpellier, France, co-hosted by INRAE and CIRAD. A virtual connection was established for network partners who were not able to travel to the meeting. The agenda of the meeting is attached as Appendix 1 and the list of participants as Appendix 2.

1. Welcome and introduction

On behalf of the local organizers, CIRAD genebank curator Paule Teres welcomed all participants to Montpellier and the EVA meeting. In Montpellier, INRAE and CIRAD are working closely together in research and the curation of the local genebank, which was recently updated. A visit to the facilities in the ARCAD building were planned for the afternoon of the second day of the meeting.

The EVA Coordinator, Sandra Goritschnig, opened the meeting, welcoming in person 30 participants from network partners and several observers from the MineLandDiv project who were interested in potentially joining the EVA Maize network. She thanked Brigitte Guesnard and her team at INRAE/CIRAD for their help in organizing the meeting and welcomed the opportunity to interact with the MineLandDiv project through a side event after the end of the EVA project meeting.

After a round of introductions, S. Goritschnig reviewed the agenda and reminded participants of the expected outcomes of the meeting, which included a discussion of the current results, the development of a detailed work plan for the project until December 2024 and a proposal for the continuation of the network after the end of the current funding period.

2. EVA networks – Update

2.1 Overview of the current status of the ECPGR Evaluation Network EVA

S. Goritschnig updated participants on developments within the EVA Maize and other networks. The EVA Maize network currently has 18 partners from nine countries, including seven breeding companies. Several potential new partners have expressed interest in joining the network and should be considered when planning for the next phase of EVA Maize.

During a general project update, S. Goritschnig reminded participants of a project and budget extension granted by the donor at the end of 2022, which allows the current project to run until December 2024 and provides additional funds to support data analysis and communication activities and to implement a SNP viewer to display genotypic data. A promotional video for EVA is currently under preparation and will soon be released, incorporating footage provided by various EVA project partners. Furthermore, in a recently granted budget revision, additional ~€ 50,000 were made available by the donor for use in 2023, contributing to additional experiments on pepper and carrot, improving data management in EURISCO-EVA and the organization of a project meeting for the preparation of a future EVA Legumes network. This new EVA Legumes network is currently under development through the grant scheme activity 'Fostering the need of implementation of the ECPGR European Evaluation Network (EVA) on Grain legumes' (ForEVA), of the ECPGR Grain Legumes Working Group (WG) under the leadership of WG Chair Creola Brezeanu. The project, which has 23 project partners (mainly genebank curators and researchers), has so far attracted more than 35 stakeholders (private and

public sector breeders and researchers) and met in Bucharest on 10-11 October 2023 to develop a work plan for the future EVA Legumes network, which is due to start in 2024. The EVA Legumes network will work on seven different crops (beans, fava beans, peas, lentils, chickpeas, lupins and orphan legumes), with between 15 and 25 network partners projected to contribute to the different crop groups. In 2024, ECPGR is also starting a new Phase XI, and the EVA networks have been firmly integrated into the ECPGR work programme for the next five years, with guaranteed funding for coordination and EURISCO support until 2026.

In terms of dissemination of project results, partners were informed of the recently published article by Tripodi *et al* in *Frontiers in Plant Sciences*[1], describing the work of the EVA Lettuce network. Other opportunities for dissemination and communication were highlighted and partners invited to report their local, national and international dissemination activities to the EVA coordinator for reporting to the donor.

2.2   Review of EVA Maize network work plan 2020–2024

Partners were reminded of the agreed work plan and timeline for the different planned activities between 2020 and 2024. By now, evaluations of two sets of accessions have been finalized and the first year of Set 3 evaluations conducted. In total, 612 genebank accessions from nine holding institutes have been evaluated, as well as 240 testcross hybrids from selected accessions. Another set of 108 hybrids are currently in production in partners' winter nurseries and will be evaluated in 2024. EVA Maize network partners have so far conducted 95 evaluation trials in 25 locations across Europe.

In 2024, no new accessions will be evaluated, the focus will be on in-depth evaluations (B and C) of Set 3 and perhaps repetition of some trials that failed due to adverse conditions. An important emphasis of the work planning in 2024 will also be data management and analysis as well as dissemination and exploitation of the generated results. In addition, the collaboration with the MineLandDiv project should be agreed and a plan for activities in 2025 developed.

The planning of field trials for 2024 should be finalized by end of February 2024 to allow timely distribution of seeds. Partners were asked to confirm their availability for trials in 2024, and genebanks should check their stocks of Set 2 accessions to potentially supply replicated trials.

3. Review of experiments and preliminary data

3.1   Overview of trials on hybrid populations (Evals 1C and 2C) from 2022-2023

Aloïs Gourrion (RAGT) provided his first impressions on hybrid evaluations conducted at their trial site in France in 2022 and 2023. Weather conditions in those two years were quite different with an extended heatwave in 2022. In general, they note the performance of EVA hybrids well below that of the check hybrids.

Amelie Le Foll (MAS) noted significant root lodging and heterogeneity in their trials of hybrid populations in France.

Gwaenelle Gossart (Lidea) apologized for the delay in receiving back hybrid populations from their winter nursery in Chile due to late harvest. To compensate, they conducted extra trials in

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[1] https://doi.org/10.3389/fpls.2023.1252777

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several locations in France and Switzerland where their populations were tested. They noted that the earliest check hybrid had a very bad emergence and did not perform as expected, which was also observed in other partners' trials. In general, trials had significant root lodging and EVA hybrids did not reach the performance of check hybrids.

Violeta Andjelkovic (MRIZP) presented trials on late-maturity hybrids conducted in Serbia. In 2022 there was a heatwave in Serbia, and material was tested in three locations which showed significant differences in yield potential. Trials in 2023 were conducted in three locations as well. However, due to late sowings and several storms during the season, only one location provided reliable data. Since no late maturity hybrids will be prepared for Set 3, MRIZP may repeat the evaluations 2C next year. In general, different behaviour was observed in different locations and also performance of hybrids was dependent on the tester used to generate the population.

All partners appreciated the assistance provided by INRAE with seed logistics and trial planning. Considering the weather conditions in 2022, it may be interesting to check the collected data from that year to identify potentially drought-resistant accessions.

3.2   Overview of trials on per se accessions (Evals 3A and 2B) from 2022-2023

Natalija Kravic (MRIZP) gave an overview of the evaluations of per se accessions, conducted at Zemun Polje in 2023. In their evaluations, plots with >17 plants were considered full stand, and plots with fewer plants were corrected in yield calculations. The trials experienced bird attacks and several heavy storms during the summer. Interestingly, the two parallel experiments had differences in the number of accessions with synchronous flowering.

Ros Ana Malvar (CSIC) noted that it may be better to score Kernel type and colour on the original seed batch harvested at multiplication, since cross-pollination during the evaluation could affect colouring on the ear. She suggested that this trait should be evaluated by the holding institute and not after harvest.

Bettina Kessel (KWS) connected online and presented an update on their disease trials in six locations across Europe. Unfortunately, the NCLB trials failed in all locations due to weather-induced lodging which made scoring impossible. These trials may be repeated in 2024 together with evaluations 3B, ideally at two sites per location to lower the risk of trial failure. The Fusarium trials had overall good results, with several resistant accessions identified and overall good heritability observed. Gönül Comertpay (DATAEM) noted that they have some resistant late-maturity materials in their collections.

Cyril Bauland (INRAE) summarized the trial conducted by INRAE in Brittany on the full Set 3. The trial had been designed using Rdigger with 12 incomplete blocks and three internal hybrids in addition to the EVA checks to facilitate comparisons. Preliminary analysis was conducted using two models, a linear vs. a mixed model, which provided similar results. In general, good heritability was observed for all traits and the trial location is ideal to screen for earliness. They observed a good correlation between plant height and days to silking. Data for anthesis silking interval revealed cold stress for late maturing accessions. V. Andjelkovic noted that the location in Brittany may not be ideal for late-maturing materials, and more suitable for silage than grain maize. G. Comertpay noted they also use later maturing materials in Turkey and suggested to cut extra emerging seedlings to ensure even numbers of plants per plot. Using freshly multiplied seed can also improve even germination.

Hrvoje Šarčević (UZagreb) reported on their trials in 2022 and 2023, which had both been hot but with low and high precipitation, respectively. All traits except yield traits from the 2023 trial have already been uploaded to the database. He noted that while days to heading showed similar results in check hybrids between 2022 and 2023, the late maturity check hybrids grew taller in 2023 than in 2022.

Carlotta Balconi (CREA) updated on their trials in Bergamo in 2023, which had more favourable conditions compared to 2022. Initial PCA indicated correlation between yield traits and also between flowering traits and height. They also observed some Fusarium infection on ears but not stalks. Both CREA and UZagreb may be able to conduct evaluations of hybrid populations in 2024, since there are no evaluations A planned for next year.

Pedro Mendes Moreira (ESAC) reported on their trials in Portugal in 2023, noting several problems experienced during the growing season, including some infections with *Ustilago maydis*. He highlighted the importance of kernel colour for grain maize used for cooking.

R. A. Malvar (CSIC) reported on their trials on Set 1 accessions under controlled conditions, including early and optimal sowing date, Fusarium and Sesamia infections. Experiments were repeated on 52 accessions over two years in 2022 and 2023, with the overall goal of identifying useful material for biotic and abiotic stresses. Initial comparison of data from the two years showed some differences for all traits across the two experiments. Fusarium infection affected yield less than Sesamia, however, those showing yield loss after infection already had low yield. She also noted a correlation between flowering time and Fusarium infection, which may be due to the infection method (before flowering). G. Comertpay noted that at their location in Adana, Turkey maize is only sown as a first crop of the season due to endemic Sesamia occurrence.

Even though not having been able to attend the meeting, Alexandre Strigens (DSP) shared a presentation summarizing their trials in 2022 and 2023. In the per se evaluations of 2022, conducted at three sites in Switzerland, he noticed a wide range of maturity even within the early subset, which matured three weeks earlier than in 2021. He identified some materials with good standing ability and observed varying levels of common smut infections. In his trials grain moisture and flowering time showed different correlations, hinting at different dry-down behaviours of the materials. Hybrid populations were evaluated in three locations in 2022, also to compensate for seed distribution issues. Two locations were strongly affected by drought and populations in general showed large variations in yield. Per se evaluations in 2023 were lost due to bird attacks and storms, also one location of hybrid evaluations was affected. Data from the second location for Eval2C were collected and will be uploaded to the EURISCO-EVA database in due course.

4. Data analysis

4.1 Updates on preliminary data analysis: per se Evaluations A

R. A. Malvar presented initial results from the analysis of data of the per se accessions evaluations. Six hundred and twelve maize accessions were evaluated in 26 trials at 11 locations during three seasons (2021–2023) designed as replicated check experiments augmented by un-replicated entries. Best Linear Unbiased Estimator (BLUE) for each variety was calculated based on the pooled data from all environments, which is important for further association analyses. Initial analyses focused on flowering time and plant and ear height, as these traits are also part of a planned publication. The data were linked with existing genotypic grouping and origin of the

accessions and correlation analyses performed to identify significant patterns. Among the 612 accessions, 273 were not assigned to specific genetic groups, suggesting a level of admixture. PC analysis identified variables explaining plant architecture and flowering, which were used to group accessions into six clusters based on similarities. There are two large clusters and four smaller clusters, with different compositions based on geographic origin and holding institute. Similar analyses were also started on other traits including early vigour, lodging and grain yield, also yielding clusters with six groups. Further analysis will be conducted on the full dataset (some post-harvest data are still missing), to initiate also association analysis. At the moment it appears that the data is unbalanced for use in GxE interaction analyses. It will probably be necessary to group environments and varieties and to include also general data from the B evaluations. Furthermore, specific traits evaluated in evaluations B will be analyzed once trials have been completed in 2024.

4.2 Updates on preliminary data analysis: testcross evaluations C

C. Bauland presented an update on evaluations of testcross hybrids (Evaluations C). At the moment only data from the first set (1C) are fully available, data from 2023 (2C) are still being collected/curated and the third set (3C) will be evaluated in 2024. Due to seed logistics issues, for 2C only one location evaluated populations with all three testers, which makes comparisons complicated. From initial analysis, it appears that populations and locations have important effects while the tester effect is small. Anthesis-silking-intervals are large in the populations compared to the per se accessions. Furthermore, as reported by partners, one of the check hybrids behaved not as expected in several trials, which may confound results.

4.3 Discussion

In the following discussion, some suggestions were made on how to compare data from the different trials, which use common checks but different designs. It may be useful to redo the subgrouping for hybrid crossings using the full set of accessions and also taking into account the genotyping data of testers in the analysis. Furthermore for accessions that have not been clearly assigned to a genetic group (< 0.6 value), regression analysis should be done to assign grouping, and admixed groups could also be assigned. A diversity analysis of the entire collection could be very interesting and the collected data could produce several interesting publications.

Breeding company partners reiterated that for their breeding programmes, the outputs they would like from the analysis are identifying accessions that would be most suitable for hybrid production and also those that have good performance with special traits (specifically biotic/abiotic stresses and lodging), i.e. those that have the most benefit with least negative effect. Some partners may also be interested in including pre-breeding activities with interesting accessions in a future EVA Maize work plan.

It was noted that some of the EVA accessions have also been included in other projects and were evaluated for biotic and abiotic stresses. Most trials in the per se evaluations recorded disease symptoms based on natural infection (ear rot/ear damage), for which heritability is lower, also because the specific strain is unknown as well as the disease pressure present in the field. It was suggested to include appropriate susceptible and resistant controls in the trials, which is already done for the controlled disease trials. Evaluators could check back in their field books to assess the severity of disease pressure in the conducted trials, thus allowing further analysis.

5. Dissemination and exploitation

5.1   Update on dissemination activities and publication planning

Partners provided an update on dissemination activities at national and international level. These activities will be collected on SharePoint in a table to be shared with the funding agency and for information on the EVA website.

INRAE presented the EVA network at an internal seminar with a focus on animal and plant breeding. Stephane Nicolas and Agustin Galaretto also presented a poster at *Plant Biology Europe 2023* in Marseille where they combined data from different projects including EVA to present an in-depth diversity study linked with GWAS and genomic prediction of flowering traits. He noted that the predicted flowering time within the EVA collection showed a good correlation with their assigned FAO maturity rating. Several options for valorizing the genotyping data collected in EVA were proposed, including an approach to predict (adaptative) traits in landraces maintained in genebanks by genomic selection, perform a deeper genetic structure analysis and GWAS on interesting traits scored in different environments. For this, it was noted that sufficiently informative metadata of the individual trials should be available, including sowing/harvesting dates and GPS locations of the trials.

C. Balconi shared activities where CREA promoted the EVA network and invited partners to do the same. She is also leading the drafting of a paper in preparation for a special issue of *Biology* which was discussed in the meeting by the drafting group. Partners reiterated their intention to publish several papers from the large amount of data collected in the network. One publication exploiting the genotyping data could focus on GWAS and genomic selection, which could perhaps be used to predict hybrid progeny of landraces. Phenotypic data from the different evaluations of per se accessions and hybrid testcrosses could also feed into several papers and ideas and outlines should be collected from partners interested in leading these initiatives.

5.2   Review and discussion on manuscript for special issue of *Biology*

The manuscript is in preparation for a special issue of the journal *Biology* on 'Conservation Genetics as a Management Tool for Endangered, Vulnerable, and Threatened Species'. It will combine an overview of the participating genebanks and their EVA maize collections with a limited genetic diversity analysis and some phenotypic data. It was agreed that only landraces should be included in the paper, and any inbred lines should be removed from the datasets. The controls/check hybrids included in the trials should be coded with their EVA codes, which include the FAO maturity rating. When displaying genetic grouping data it was suggested to create codes with origin country and number for the figures, so there would be less text. Colour scales should be used to identify groups in PCA figures.

Partners discussed how to publish the underlying raw data for the paper, as it could be too complex for supplemental data files. It was suggested to include accession numbers and relevant passport data (accession name, holding institute, origin country, sampstat) and BLUES of the traits presented as Supplemental Data for the manuscript. Additional data tables should list the numbers of locations an accession was evaluated in and another supplemental table could list trials and relevant metadata (as long as it's not sensitive information). Raw data could be published in a dataverse database with DOI and an appropriate copyright/license, if necessary.

Eventually, the raw data should also be included in EURISCO, upon approval of the national coordinators.

The new submission deadline for the manuscript is the end of March 2024 and the drafting group agreed to aim to finalize the paper by February.

6. Outlook – EVA Maize 2.0

6.1 MineLandDiv project presentation and possible interactions

S. Nicolas presented the Suscrop-ERAnet project MineLandDiv (Mining allelic diversity of maize landraces for tolerance to abiotic and biotic stresses) which is led by INRAE and running from March 2023 to February 2026, providing a possibility for EVA Maize to continue network activities complementing the planned project activities. MineLandDiv involves several EVA partners (INRAE, CREA, CSIC) as well as other research institutes which could become partners of EVA (U. Bologna, UC Louvain, TAGEM). Representatives of these were invited to the meeting and a side meeting of the project was planned after the EVA project meeting.

MineLandDiv is building on the fact that few landraces contributed to modern breeding germplasm and recurrent selection progressively erodes genetic diversity leading to a loss of allelic diversity. It is therefore aiming to identify untapped sources of genetic diversity for prebreeding and new traits required for low-input agriculture and for facing climate change. To do this the project combines field and platform phenotyping, DNA bulk genotyping and sequencing, GWAS and genomic prediction on a set of 300 maize landraces, of which around 50% have been selected from the EVA collection. Targeted sequencing using SPET technology (using a 600k SPET Panel) will also provide the necessary SNP density to detect important QTLs; this is planned for > 700 landraces. In addition, phenotypic data is available for > 1,500 partially geolocalized landraces, allowing prediction for important traits.

Thus, the EVA network has contributed to the MineLandDiv project by creating a diverse collection of landraces, from which a core collection was created based on phenotypic and genotypic data. Genebanks have also provided seeds of these accessions for further multiplication. In the future, EVA could contribute as third-party evaluators, extending the field evaluations of MineLandDiv. EVA data could also be combined with that generated by MineLandDiv to improve genetic prediction models. Furthermore, genotyping/sequencing of new landraces not yet in EVA (e.g. Bulgaria or Turkey) could feed into future EVA activities. EVA coordinator S. Goritschnig and Maize WG chair V. Andjelkovic were invited to join the MineLandDiv Steering Committee.

Another Horizon project, DROMAMED, joins some EVA partners with other research institutions around the Mediterranean, and is working on capitalizing Mediterranean maize germplasm for improving stress tolerance. The project uses inbred lines and landraces that could also complement the existing EVA collection in further activities.

It was noted that landraces could be quite heterogeneous, due to limited contamination from cross-pollination. Flowering time and plant height especially are highly dependent on the environment and a protocol for these traits is under development to take heterogeneity into account. One suggestion was to develop subsets of the maize collection specifically for certain abiotic stresses, e.g. drought and cold, since it was considered unlikely that both could be covered by the same accessions. It was clarified that there are physiological commonalities between heat

and cold stress as they both affect the water management of the plant, for GWAS it is better to have a larger set. One option would be to evaluate the full accession set in 2024 and create subsets that could be evaluated in 2025 in multiple locations to increase the chances of catching the stress. The subset should be representative of the collection. However, specific subsets for cold or drought stress could be selected based on flowering and origin.

6.2   International cooperation beyond Europe

Alain Charcosset presented a visit to the North Central Regional Plant Introduction Station (NCRPIS) of USDA in Ames, Iowa, where he presented the EVA project and discussed possible synergies and opportunities for collaboration, building also on previous experiences. He noted a common interest in landrace genotyping and applications and a strong interest in integrating EVA and INRAE data with those existing in the US (also possibly CIMMYT seeds of discovery). USDA has a large collection of landraces, experience in creating inbred lines and capacities for phenotyping including NIRS for trait prediction, but a framework for cooperation and relevant funding will need to be further discussed. Discussions will continue during the international maize meeting in Raleigh, USA in February 2024. He also briefly presented a preprint manuscript of his PhD student D. Sanchez who showed that genetic resources can bring favourable improvement to elite lines in breeding.[2]

It was suggested to check the USDA landrace collection for duplicates of European landraces. G. Comertpay has previously tested ~350 USDA accessions, which were mostly inbred lines.

6.3   Proposals for EVA Maize 2.0 – continuation of network activities

The discussion on proposed activities for a continuation of the EVA Maize network beyond 2024 started with a round table brainstorm, where all partners shared their priorities. They generally confirmed their commitment to continue in the EVA Maize network for the next phase, inviting also new partners to the network.

A. Gourrion (RAGT) suggested that a global analysis of results should be done (multilocation, testers and per se together, and diversity). Their main traits of interest are yield, lodging, disease resistance. Information on maturity is good to know but not limiting.

B. Kessel (KWS) suggested creating a catalogue of tested accessions, including yield and extra traits (kernel colour, FAO maturity rating), similar to what has been done at USDA. EURISCO should serve as such a catalogue. To make it more useful for users more photos should be added to accessions.

G. Gossart (Lidea) indicated yield, Fusarium resistance and lodging as main traits of interest. It would also be interesting to identify indicators about the diversity (main groups) and to know how to introduce this into elite material.

LeFoll (Mas Seeds) expects a focus on the global analysis of the data from the three sets evaluated so far, with the goal to highlight some landraces. In future activities, they suggested adjusting the network and focus on specific traits (cold, drought) and creating a common set of

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[2] https://www.researchsquare.com/article/rs-3009231/v1

phenotyping (protocols, proxy traits for abiotic stresses). On a technical level, she suggested improving seed distribution (presently difficult to manage the small seed amounts, it is time consuming, and SMTA limiting as they are not allowed to sign). It was noted that there are several options for signing an SMTA, including one in which accepting the package means accepting the conditions of the SMTA. However, which version is used depends on the requirements of both sending and receiving entities.

Jean Beigbeder (Promaïs) noted that the French public–private partnership project Promaïs (including nine French companies) has been operational for more than 30 years on breeding and genetic resources conservation and had met the day before to redefine objectives. He congratulated partners on the progress in EVA which he considers fully in line with Promaïs' objectives.

G. Comertpay (BATEM) attended the EVA network meeting for the first time but was interested in continuing collaboration and joining the network. She indicated interest in characterizing maize for grain properties and other characteristics and has done such experiments on accessions from the USDA catalogue.

François Chaumont (UC Leuven) is a partner in MineLandDiv with expertise in root phenotyping and a special interest in diversity around specific genes, such as aquaporins.

C. Balconi (CREA) also expressed interest in continuing the EVA collaboration and providing more materials. Considering that no evaluation of per se accessions is planned for 2024, they could perform a trial with hybrids, with a focus on production traits. She suggested that combining EVA data with datasets from Dromamed and MineLandDiv could be useful, also datasets from smaller national trials could be integrated. For this, it will be important to keep track of all evaluations. Going forward and depending on the available budget, it could also be useful to further characterize smaller sets of accessions. To save on travel time and budget it could also be useful to combine meetings for the various projects involving the same partners.

Elisabetta Frascaroli (U Bologna) would be interested in exchanging material with the EVA network. Their expertise is also in root phenotyping.

Pedro Revilla (CSIC) confirmed their intention to continue the EVA collaboration and proposed to include additional collections (e.g. Turkey, Mediterranean countries) and thus connect with the Dromamed project, volunteering himself to take the lead for this connection. They are specifically interested in grain quality traits for food (e.g. popcorn for Spain and Turkey) and colour traits, and also combining ability. He suggested that results could be further capitalized by generating locally adapted inbred lines for pre-breeding and breeding. National funding could be available for interesting projects.

Beate Schierscher (Agroscope) expressed satisfaction with their participation and to see their material evaluated. She emphasized that it will be important to include the phenotypic data in their genebank documentation. So far, only half of their collection has been described, it would thus be nice to continue.

V. Andjelkovic (MRIZP) noted that their institute is interested in continuing the collaboration and further multiplying new accession sets. Trials that failed in 2023 could be repeated in 2024, since no new sets are currently available. They may also be interested in expanding the collaboration to (pre)breeding for important traits and suggested that a survey among partners should be conducted to identify interests and priorities. MRIZP would also like to contribute to MineLandDiv as a third party, if possible.

Danela Murariu (Suceava genebank) was also in favour of continuing the EVA maize collaboration and suggested evaluating subsets with the same traits, focusing on biotic stress traits. She noted the importance of effectively disseminating project results through publications or (inter)national conferences to provide visibility to possible funding bodies.

P. Mendes Moreira (ESAC) considered EVA very interesting for the synergies it provides, the contact with other researchers, learning opportunities and the exchange of knowledge and materials. It will be interesting to compare observations from the multilocation trials. Although they have limited resources to contribute to the EVA project they consider it important to continue in this wonderful platform. The network is also useful to learn about other projects and activities, providing visibility and he noted his own collaboration with [GreenBotics](), a project working on using robotics in agriculture, who collected data from Pedro's field. They work a lot on participatory plant breeding for companies, which could be complementary to the work in EVA. He highlighted the importance of organic seeds in future (the need for 25% according to the EU Green Deal), which could provide opportunities for further EVA activities. He also invited partners to the EUCARPIA meeting on low-input agriculture in Coimbra in May 2025, where EVA Maize should present their results.

H. Šarčević (U Zagreb) wants to continue collaborating in EVA Maize, and can contribute to evaluations B or C in 2024 if needed.

Anne Zanetto (INRAE) was happy to see the increasing interest in landraces through the EVA project and Maize WG, which is rewarding after working on conserving the collection for 18 years. Morgane Vincente is taking over after her retirement and looking forward to continuing the collaboration. INRAE has developed an exemplary protocol for multiplication and maintenance of landrace populations, which should be published. S. Nicolas highlighted the importance of genotyping, especially for landraces. New protocols for effective genotyping of genebank accessions for management purposes are under development (using arrays or sequencing), which will be very useful for collection managers. Claude Welcker agreed that it would be difficult to test all conditions but suggested expanding conditions, and agrees with V. Andjelkovic to perform screening according to phenology groups. C. Bauland agrees to support the trials and finalize data analysis of hybrid evaluations. B. Guesnard is looking forward to seeing the results from combining phenotypic and genotypic data from the EVA maize collection. A Charcosset supported characterization for food and noted the dual use of maize genetic resources in breeding more diverse elite lines and also through direct use of improved landraces in niche markets.

6.4   Development of work plan for EVA Maize 2.0

S.Goritschnig outlined the work plan for 2024, which will focus on finalizing planned evaluations, data analysis and exploitation and should also work on developing a plan for activities after 2024, which could be presented to potential funders. She supported the suggestion to combine meetings of the related projects as the exchange of knowledge has proven useful in this meeting and reminded partners to continue to disseminate project results to create visibility. Within the current EVA project budget some funds are still available for use by EVA Maize in 2024, mostly to support data analysis and possibly some travel.

V. Andjelkovic proposed to apply for an ECPGR Grant Scheme activity, which could aid in expanding the EVA network to other Maize WG members, especially to Turkey, Greece or Bulgaria. A Charcosset suggested proposing experiments using NIRS, which is non-destructive grain and could be done directly on genebank materials. Traits measured with NIRS include protein, starch, ash, fibre and macro component contents. These data could be combined with results from MineLandDiv and with genotyping to be used to identify material for future cycles of EVA, particularly of not well-represented diversity. The deadline for submission of grant scheme proposals is 28 February 2024 and the maximum budget is 30,000 Euros. Violeta will lead the proposal development, involving EVA partners and the Maize WG.
Reviewing the maize accessions available in EURISCO, several larger collection holders are not yet very involved in EVA Maize or the Maize WG, such as Greece, Poland, Ukraine, Bulgaria, Germany or Hungary. In the new Phase XI of ECPGR WG, contacts will be confirmed by National Coordinators and new active contacts should be identified.

Ana Maria Barata (INIAV) noted that their genebank database serves as a catalogue for accessions with an option to order them from the institute. A main effort should be directed towards realizing EURISCO as a central hub for all European genebank information systems, this is being pursued in the Horizon project Pro-GRACE, which aims at laying the groundwork for establishing a European Research infrastructure for plant genetic resources. An important aspect for the coming year will be to discuss how EVA phenotypic evaluation data should be curated before insertion into EURISCO, to be most useful. She also noted that if breeders are interested in continuing the EVA Maize collaboration it would be important to proceed with a continuous approach, following the work plan established so far.

6.5   Final discussion

Partners agreed to the work plan for 2024 as proposed. Evaluation activities should be confirmed by end of January 2024, to ensure that seed distribution can be finalized in time. Data analysis should focus on the priorities of partners and a survey will be conducted to identify these for the current and future work. Volunteers are sought for global analysis of the results as suggested. Available budget will be allocated to analysis activities.
Three main papers were proposed to be prepared for dissemination of EVA results, the manuscript in preparation for *Biology*, one paper on the global analysis of diversity comparing per se accessions and test cross hybrid populations and one paper on GWAS. Additional publication ideas may arise from interesting results.

The grant scheme proposal of the Maize WG should be led by V. Andjelkovic and could include non-WG members as self-funded partners.

Considering that ECPGR will continue to support EVA networks in terms of coordination and data management, a continuation of the EVA Maize network after the end of the current project is possible, using existing synergy and applying the same protocol as EVA1.0 with per se and hybrid evaluations on new sets of accessions determined as not well represented yet by the Grant Scheme activity.

7. Wrap-up of meeting

S. Goritschnig summarized the main results of the discussions during the meeting and actions to be taken by participants (see action list in Appendix 3). She thanked all partners, including those connecting online for their active participation and especially local hosts INRAE and CIRAD for their assistance with logistics.

A. Charcosset thanked participants for the discussions and expressed satisfaction with the progress made during the meeting.

The next meetings will be held virtually and a first one is planned in early 2024 to finalize the evaluation work plan for the year. Another in-person meeting may be possible depending on available funds, but will be confirmed later.

The meeting finished with an interesting visit to the INRAE/CIRAD facilities, which include a newly established seed storage facility with robotics, various laboratories and a cryopreservation unit.

Appendix 1. Meeting agenda

Venue: Agropolis International (CIRAD), Montpellier, France

TUESDAY 28 NOVEMBER		
08:30 – 09.00	Registration - Salle Badiane	
	Welcome and introductory session	**CHAIR: B. GUESNARD**
09.00 – 09.10	Welcome by local host, ECPGR	*P. Teres* *S. Goritschnig*
09.10 – 09.20	General update on the EVA Networks	*S. Goritschnig*
09.20 – 09:45	Review of EVA Maize network workplan 2019-2024 - planning activities in 2024 - updates on experimental plan	*S. Goritschnig*
	Review of experiments and preliminary data	**CHAIR: V. ANDJELKOVIC**
09.45 – 10:30	Overview of trials on hybrid populations (Evals 1C and 2C) from 2022-2023 (5 mins each)	*A. Gourrion (RAGT)* *A. Le Foll (MAS)* *G. Gossart* *(Lidea)* *V. Andjelkovic (MRIZP)*
10.30 – 11:00	**TEA/COFFEE BREAK**	
11.00 – 11:45	Overview of trials on per se accessions (Evals 3A and 2B) from 2022-2023 (~5 mins each) - Traits evaluated - Characterization data - Preliminary results from disase trials - Lessons learned and suggestions for upcoming trials	*N. Kravic (MRIZP)* *C. Bauland (INRAE)* *C. Balconi (CREA)* *B. Kessel (KWS, online)* *H. Sarcevic (UZagreb)* *P. Mendes Moreira (ESAC)* *R. Malvar (CSIC)*
	Data Analysis	**CHAIR: P. REVILLA**
11.45 – 12:30	Updates on preliminary data analysis • Evaluations A and B • Evaluations C	*R. Malvar* *C. Bauland*
12:30 – 13:00	Discussion	*All*
13:00 – 14.10	**LUNCH**	
	Dissemination and Exploitation	**CHAIR: C. BALCONI**
14:10 – 14:30	Update on Dissemination activities at (inter)national conferences	*S. Nicolas* *V. Andjelkovic* *All*
14.30 – 15:30	Publication/exploitation planning	*C. Balconi/All*
15.30 – 16:00	**TEA/COFFEE BREAK**	
16:00 – 17:30	Review and discussion on manuscript for special issue of „Biology"	*Drafting group/All*

18:30	CITY TOUR AND SOCIAL DINNER	

Venue: Agropolis International, CIRAD, Montpellier, France

WEDNESDAY 29 NOVEMBER		
	Outlook – EVA Maize 2.0	CHAIR: A. CHARCOSSET
09.00 – 09.30	MineLandDiv project presentation and possible interactions	*S.Nicholas; MineLandDiv partners*
09.30 – 09.40	International cooperation beyond Europe	*A. Charcosset*
09.40 – 10.30	Proposals for EVA Maize 2.0 – continuation of network activities	*All*
10.30 – 11.00	**TEA/COFFEE BREAK**	
11.00 – 12.30	Development of work plan for EVA Maize 2.0	*All*
12:30 – 13:00	Final discussion and wrap-up	*All*
13.00 – 14.10	**LUNCH**	
	Excursion	
14.10 – 16:30	Visit to INRAE/CIRAD genebank facilities	*B. Guesnard/P. Teres*
16:30	*End of meeting*	

Appendix 2. List of participants

Violeta Andjelkovic
Maize Research Institute Zemun Polje
Slobodana Bajica 1
11185 Belgrade - Zemun Polje
Serbia
Email: violeta@mrizp.rs

Cyril Bauland
INRAE - Génétique Quantitative et Évolution
Le Moulon - Université Paris-Sud - CNRS -
AgroParisTech
12 Route 128
91272 Gif sur Yvette
France
Email: cyril.bauland@inrae.fr

Carlotta Balconi
Consiglio per la Ricerca in Agricoltura e
l`Analisi dell`Economia Agraria, Centro di
Ricerca Cerealicoltura e Colture Industriali
(CREA-CI), Sede di Bergamo
Via Stezzano 24
24126 Bergamo
Italy
Email: carlotta.balconi@crea.gov.it

Alain Charcosset
INRAE - Génétique Quantitative et Évolution
Le Moulon - Université Paris- Saclay - CNRS -
AgroParisTech
12 Route 128
91272 Gif sur Yvette
France
Email: alain.charcosset@inrae.fr

Francois Chaumont
UC Louvain,
Croix du Sud 4 L7.07.14
Belgium
Email : francois.chaumont@uclouvain.be

Gönül Comertpay
TAGEM/DATAEM (Eastern Mediterranean
Agricultural Research Institute)
Karatasyolu 17 Km.Dogankent/Yuregir/Adana
Türkiye
Email: gonul.comertpay@gmail.com

Matteo De Biasi
DISTAL - University of Bologna
viale Giuseppe Fanin, 44,
Bologna
Italy
Email : matteo.debiasi3@unibo.it

Elisabetta Frascaroli
DISTAL - University of Bologna
viale Giuseppe Fanin, 44,
Bologna
Italy
Email : elisabetta.frascaroli@unibo.it

Agustin Galaretto
INRAE - Génétique Quantitative et Évolution
Le Moulon - Université Paris-Sud - CNRS -
AgroParisTech
12 Route 128
91272 Gif sur Yvette
France
Email: agustin-oscar.galaretto@inrae.fr

Gwenaelle Gossart
LIDEA Seeds
6 chemin de Panedautes 31700 Mondonville
France
Email: gwenaelle.gossart@lidea-seeds.com

Brigitte Gouesnard
INRAE - Centre de Montpellier
Batiment ARCAD. Rue Arthur Young
34000 Montpellier
France
Email: brigitte.gouesnard@inrae.fr

Aloïs Gourrion
RAGT 2n
22 bis Le bourg
28200 Villampuy
France
Email: AGourrion@ragt.fr

Joséphine Guyot
UC Louvain,
Croix du Sud 4 L7.07.14
Belgium
Email:

Natalija Kravić
Maize Research Institute Zemun Polje
Slobodana Bajica 1
11185 Belgrade - Zemun Polje
Serbia
Email: nkravic@mrizp.rs

Amelie Le Foll
MASSeeds
Route de St Sever,
40280 Haut-Mauco
France
Email: lefoll@maisadour.com

Rosa Ana Malvar
Mision Biologica de Galicia, CSIC
Apartado 28
Pontevedra 36080
Spain
Email: rmalvar@mbg.csic.es

Danela Murariu
Suceava Genebank
B-dul 1 Mai nr. 17
720224 Suceava
Romania
Email: danela.murariu@svgenebank.ro

Pedro Manuel Reis Mendes Moreira
Departamento de Ciência Agronómicas
Politécnico de Coimbra – Escola Superior
Agrária de Coimbra
3045-601 Coimbra
Portugal
Email: pmm@esac.pt

Stephane Nicolas
INRAE - IDEEV, GQE-Le Moulon,
12 route 128,
91172 Gif-sur-Yvette,
France
Email: stephane.nicolas@inrae.fr

Rita Redaelli
Consiglio per la Ricerca in Agricoltura e
l`Analisi dell`Economia Agraria, Centro di
Ricerca Cerealicoltura e Colture Industriali
(CREA-CI), Sede di Bergamo
Via Stezzano 24
24126 Bergamo
Italy
Email:

Pedro Revilla
Mision Biologica de Galicia, CSIC
Apartado 28
Pontevedra 36080
Spain
Email: previlla@mbg.csic.es

Christophe Reynaud
INRAE - Centre de Montpellier
Batiment ARCAD. Rue Arthur Young
34000 Montpellier
France
Email: christophe.raynaud@inrae.fr

Dimitri Sanchez LIDEA Seeds France
LIDEA Seeds
6 chemin de Panedautes 31700 Mondonville
France
Email: dimitri.sanchez@lidea-seeds.com

Hrvoje Šarčević
Faculty of Agriculture; University of Zagreb
Svetošimunska 25
Zagreb 10000
Croatia
Email: hsarcevic@agr.hr

Beate Schierscher-Viret
Agroscope
Route de Duillier 50
1260 Nyon 1
Switzerland
Email: beate.schierscher-
viret@agroscope.admin.ch

Francesco Solimei
DISTAL - University of Bologna
viale Giuseppe Fanin, 44,
Bologna
Italy
Email: francesco.solimei@unibo.it

Paule Teres
CIRAD
Batiment ARCAD. Rue Arthur Young
34000 Montpellier
Email: paule.teres@cirad.fr

Morgane Vincent,
CRB GAMéT (INRAE)
Batiment ARCAD. Rue Arthur Young
34000 Montpellier
Email: morgane.vincent@inrae.fr

Anne Zanetto
INRAE - Centre de Montpellier
Batiment ARCAD. Rue Arthur Young
34000 Montpellier
France
Email: anne.zanetto@inrae.fr

ECPGR Secretariat

Sandra Goritschnig
The Alliance of Bioversity International & CIAT
Via San Domenico 1
00153 Rome
Italy
Email: s.goritschnig@cgiar.org

Online participants

Ana Maria Barata
Banco Português de Germoplasma Vegetal
Instituto nacional de Investigação Agrária e
Veterinária (BPGV-INIAV)
Quinta de S. José S. Pedro de Merelim
4700-859 Braga
Portugal
Email: anamaria.barata@iniav.pt

Jean Beigbeder
ProMaïs
France
Email: jeanbbd@wanadoo.fr

Mesut Esmeray
MRI
Türkiye
Email: mesut.esmeray@tarimorman.gov.tr

Filippo Guzzon
ECPGR Secretariat
The Alliance of Bioversity International & CIAT
Via San Domenico 1
00153 Rome
Italy
Email: f.guzzon@cgiar.org

Bettina Kessel
KWS SAAT SE & Co. KGaA
Grimsehlstrasse 31. 37574 Einbeck
Germany
Email: bettina.kessel@kws.com

Delphine Madur
INRAE - Génétique Quantitative et Évolution
Le Moulon - Université Paris-Sud - CNRS -
AgroParisTech
12 route 128,
91172 Gif-sur-Yvette,
France
Email: delphine.madur@inrae.fr

Thomas Presterl
KWS SAAT SE & Co. KGaA
Grimsehlstrasse 31, Postfach 1463
37574 Einbeck
Germany
Email: thomas.presterl@kws.com

ROUX Antoine
MASSeeds
Route de St Sever,
40280 Haut-Mauco
France
Email: a.roux@maisadour.com

Alessio Torri
CREA Consiglio per la ricerca in agricoltura e
l'analisi dell'economia agraria
Via Stezzano 24, 24126 Bergamo, Italy
Email: alessio.torri@crea.gov.it

Claude Welcker
INRAE
France
Email: claude.welcker@inrae.fr

Appendix 3: Action list

#	Activity	Action	Responsible	Due date
1	Eval 3B	Finalize trial plan per se evaluations (including repeats of 2B)	S. Goritschnig, all partners	31-Jan-24
2	Eval 3B	Create trial matrix for subset 3B and evaluation sites	S. Goritschnig	31-Jan-24
3	Eval 3C	Finalize trial plan for hybrid evaluations	S. Goritschnig, all partners	31-Jan-24
4	Eval 3C	Create trial matrix for hybrid populations and evaluation sites	S. Goritschnig	31-Jan-24
5	evaluations	Genebanks to check seed stocks for set 2 accessions	genebanks	31-Jan-24
6	Evaluations	Provide deadlines for receipt of seeds for different evaluations	all evaluating partners	31-Jan-24
7	Work planning	Update information in workplan for set 2 and 3	all partners	31-Jan-24
8	evaluations	Virtual meeting to finalize work planning 2024	all partners	Feb-24
9	dissemination	Update information on (inter)national dissemination activities featuring EVA Maize	all partners	29-Feb-24
10	evaluations	Provide missing evaluation data for curation and upload to database	all evaluating partners	29-Feb-24
11	data management	Review accession metadata in database for origin country and GPS locations	F. Guzzon, holding institutes	29-Feb-24
12	data analysis	Review assignment to genetic groups for stringency and admixture	S. Nicolas	29-Feb-24
13	dissemination	Draft of paper ready for submission	drafting group	29-Feb-24
14	Accessions	Collect geographic origin data where missing	S. Goritschnig and genebanks	29-Feb-24