D 9.4 Project annual meeting 3

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AGENDAS

ECOBREED 3rd Annual Online Meeting

4 June 2021

https://zoom.us/j/99086625316?pwd=RFZWc3VLY1NwVEtFSWY5RzVDUm1SUT09

Meeting ID: 990 8662 5316

Passcode: 923446

Friday, 4th of June | 08:30 - 15:30

08:30 – 08:40 | Testing the online platform
08:40 – 08:50 | Welcome and introduction
08:50 – 09:00 | Overall progress report
09:00 – 09:15 | Management of the project (amendment, CA)
09:15 – 10:00 | WP 2 (Wheat)
10:00 – 10:45 | WP 3 (Potato)
10:45 – 11:30 | WP 4 (Soybean)
11:30 – 12:15 | WP 5 (Buckwheat)

12:15 – 13:00 | *Break*

13:00 – 14:00 | WP 6 (Farmer participatory trials and breeding), WP 7 (Training), WP 8 (Demonstration, dissemination, exploitation and communication)
14:00 – 15:00 | REA and SAG members: synergies, cooperation, observations and recommendations
14:00 – 14:10 | Dr Monika Messmer (LIVESEED project)
14:10 – 14:20 | Prof Dr Ferdinando Branca (BRESOV project)
14:20 – 14:30 | Prof Dr Carlo Leifert (Southern-Cross University, Australia)
14:30 – 14:40 | Steven Jacobs (Organic Farmers & Growers CIC)
14:40 – 15:00 | Discussion

15:00 – 15:30 | Conclusions and closure of the meeting

ECOBREED 3rd Annual IP Sub-committee Meeting

21 June 2021

https://zoom.us/j/91800503491?pwd=dmNVTWNQbGdpSEJUcW0vOEx1TzJ2QT09

Meeting ID: 918 0050 3491

Passcode: 579216

Monday, 21st of June | 09:30 - 10:30

1. **Welcome and Introduction of the new member**
   V. Meglič
2. **Overall progress report for the Y3**
   H. Valas and V. Meglič
3. **Report on the deliverable D8.2 and key exploitable results**
   H. Valas and A. Kuhar
4. **Individual plans for exploitation**
   H. Valas
5. **Plans for Y4**
   H. Valas
6. **Scientific publications**
   V. Meglič
7. **Miscellaneous**
   V. Meglič and A. Kuhar

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1. EXECUTIVE SUMMARY

The document contains minutes and report on of the third project management meeting and IP annual sub-committee meeting, as well as 3rd IP exploitation report of the project (MS31).

Both 3rd annual meeting of the project ECOBREED and IP annual sub-committee meeting were influenced by the Covid-19 travel restrictions and were therefore held online on the zoom platform, on June 4th and 21st.

All partners were present at the annual meeting except for P21-GS. However, P21-GS partner attended preparation meetings for the WPs they are involved in. The purpose of the meeting was to report on the progress that has been achieved and discuss on-going and future activities. Specific objectives were:

- Get to know newcomers, changes in the management bodies.
- Introduce the new member of Stakeholder Advisory Group (SAG), namely Steven Jacobs and getting feedback from SAG members.
- Recapitulate the ongoing activities for each WP and progress achieved by each partner.
- Discuss the ongoing submission of the 2nd periodic report.
- Discuss and answer any outstanding questions or concerns.

IP annual sub-committee meeting was attended by all members; past and current IP issues were discussed, new member introduced.

Covid-19 has had an important influence on the exploitation and dissemination activities of the project. Nevertheless, first scientific results are already present and out of them 7 peer-reviewed articles were published in the period covering PR2.

2. Minutes 3rd annual meeting

2.1. Welcome and introduction

Project coordinator Vladimir Meglič (KIS) kindly greeted all participants of the online 3rd ECOBREED Annual meeting, Project and Policy Officers as well as members of the Scientific Advisory Board: Monika Messmer (LIVESEED project), Ferdinando Branca (BRESOV project), Carlo Leifert (Southern-Cross University, Australia), Steven Jacobs (a new member - replacing Bogdan Štepec who represents Organic Farmers & Growers).

It's been a difficult year for everyone because of COVID-19 We still have not seen each other in person, but on a positive note, more people are able to attend online meetings in this situation.

At the beginning of the meeting, some practical advice and suggestions were given on how to best run the meeting, how to use cameras and microphones, how to ask questions and some other issues.

The meeting was be recorded and general minutes were taken.

2.2. Overall progress report

Speaker Vladimir Meglič (KIS) – Co-ordinator

Short progress report on last months:

- complications caused by COVID-19 situation

- partner from Greece resigned from project due to COVID-19 situation – hence we have one partner and one country less in our consortium
- organisation of work was still as it had been, while during the General Assembly some of the issues would be addressed.

Reminder of what the project is about: The focus of ECOBREED is to improve the availability of varieties and seed suitable for organic and low input production. Activities will focus on four crop species i.e. wheat (both common *Triticum aestivum* L. and durum *Triticum aestivum* L., *T. durum* L.), potato (*Solanum tuberosum* L.), soybean (*Glycine max* (L). Merr)), and common buckwheat (*Fagopyrum esculentum* Moench.). The project will develop (a) methods, strategies and infrastructures for organic breeding, (b) varieties with improved stress resistance resource use efficiency and quality and (c) improved methods for the production of high-quality organic seed. ECOBREED species have been selected for their potential contribution to increasing the competitiveness of the organic sector.
We would really like to help organic sector to get to higher level.

Briefly what has been completed:

During last growing season, the project activities are already turned towards evaluation, and multiplication of genotypes and other materials for the needs of further studies, breeding and demonstration activities.

Work encompassed execution of studies and experiments, breeding programmes are well on their way. Educational and training material has been prepared and workshops and other educational activities planned and advertised. Participatory Plant Breeding (PPB) and Farmer Participatory Field Trials (FPT) were set up, participatory farm database established, and managed and other demonstrational events planned and already organized.

To identify potential genetic diversity for each of the core species suited to organic production systems we were evaluating biological materials from different environments across Europe and other countries with a higher uptake of organic farming. More than 900 accessions were included: 200 samples of wheat, 197 of potatoes, 256 of soybeans and 263 of buckwheat in phenotypic characterization and genotypization of core collections across contrasting environments. This will help us to create an information database available for each target crop, facilitating further use of the genetic material for ECOBREED partners.

Wheat

- Multi environment field trials were carried out common and durum wheat nursery
- Advanced phenotyping methods were applied to address specific problems, e.g. weed competitiveness or drought tolerance
- Greenhouse experiments were carried out to identify germplasm with improved mycorrhizal associations and *In vitro* experiments to test allelopathic effects
- Molecular markers were developed for common bunt resistance QTL and many crosses were carried out to transfer these QTL into adapted elite varieties by marker assisted selection (MAS)
- Producing new wheat breeding material which will be the basis for the production of new varieties
- The final crosses for two MAGIC populations including eight parental genotypes each

Potato:

- Varieties for phenotyping were planted at four locations (SI, HU, POL and UK)

- Screening for AMF compatibility
- Marker assisted selection for production of elite varieties is continuing (Late blight markers applied), with establishment of segregating populations
- Production of elite varieties and advanced breeding lines continuing

Soybean

- Prime focus on screening of genetic resources and breeding material
- The first trials of drought and chilling tolerance were done
- Soybean genotypes were evaluated for cadmium accumulation, supernodulation and disease
- tolerance, providing lists for potential parents and breeding material
- N fixing capacity screening, experiment using different innocula and a trial using different cover crops continued
- Breeding lines developed and decisions for new crossings made

Buckwheat

- 323 buckwheat accessions were evaluated in three different environments + 54 in the US
- second year of P mineralization trials completed at three localities and two sowing dates
- *in vitro* test for allelopathic impact on selected monocot and dicot weed species continued
- an optimized protocol for DNA extraction suitable for long term shipment and compliance with the new Chinese rules was developed
- crosses made towards production of new varieties (152 combinations in 2019 and 58 combinations in 2020).

Training

- started to organize training programmes and events, and tailor training material for different audiences

Dissemination and communication

- project objectives and expected outcomes have been broadly disseminated at European and international levels targeting scientific audience (Eucarpia, …), policymakers (Biofach, …), and the general public.

Submitted deliverables – in the last year we did not have that many. We still have 3 deliverables that are pending. With submission of PR2 hopefully we will be back on track and continue with materials that were submitted in the proposal.

Milestones achieved are reflecting the work that was done. More or less, everything has been achieved, except of buckwheat genotypisation, which we will hear more about in WP5 presentation.

Progress towards expected impact

Expected impacts are still relevant. The ECOBREED project will provide an increased availability and quality of seeds and varieties suited to the specific conditions of organic and low input farming. It will screen and provide germplasm for use in breeding programmes for the

improvement of the 4 target crop species. Through the project we will provide extensive training, demonstration, dissemination, exploitation and communication activities to facilitate rapid technology transfer and introduction of innovations from the project into commercial practice.

We are continuing to provide

- a basis for better availability and quality of seeds and varieties suited to the specific conditions of organic and low input farming
- additional information on genetic variation that has been added to the already existing Genebank data information services
- set of genotypes that are best adapted to the regional organic management systems, organic breeding activities will be strengthened and boosted and the genetic diversity increased
- a basis to establish a regional organic breeding programmes with the help of ECOBREED
- first training documents and joint activities with BRESOV and LIVESEED
- dissemination and communication activities to facilitate rapid technology transfer and to increase organic farmers' awareness of organic seeds and organic varieties and the necessity of using those.

2.3. Management of the project

Speaker Antoaneta Kuhar (KIS) - Project Manager

As V. Meglič (KIS) announced, many things happened in this year, we are all fed up with COVID-19 restrictions. It has big effect on our work and execution of the task, we had to be flexible – thanks to everyone for being flexible and reporting changes.

We are all looking forward to the results of the project. We have one less partner, we are running into the second part of the projects.

We are now in the month 38. We are having 22 months officially and nine more months, hopefully, if the European Commission will give us this opportunity to extend the project. The whole year was more or less highlighted with resubmission of periodic report 1, which was resubmitted in January this year.

There have been changes, which require the change of our Consortium Agreement and Amendment of the Grant Agreement. The first and most important change is the extension of the project. New decision is that we are going to open the Amendment, just after we submit the periodic report 2. Another change in the Consortium Agreement will tackle the withdrawal of the GEOKOMI from Greece due to several reasons that COVID-19 raised aside from some other challenges with work (drought, etc.). Their work has already been redistributed to other partners.

Some partners have already announced budget shifts and if by chance, any one of you would like to share any other changes that needs to be introduced, let us know.

Few words on a periodic report 2. In terms of financial reporting progress can be seen in responses and quality of financial statements. Those who get green light from Antoaneta Kuhar (KIS), please fill in your financial statements in the portal as soon as possible, so they are included to PR2.

We plan to submit the whole package on June 17th, 2021. The review meeting is going to happen on August 31st. If everything will go as planned, the payment should be received in October or November this year (2021).

According to the Consortium Agreement, we need to vote on the decision of the extension of the project with 9 months. We need the minimum of two thirds of the consortium members, according to the list of participants we have this quorum. Each Consortium Member has one vote, and this vote should come from the General Assembly Member or authorized representative.

Checking presence of GA members, 22 out of 25 were present, the pool was released.

Results of pool: 21 votes for the extension of the project and 1 against; reaching 2 thirds for the extension, the decision is that we are going to ask the European Commission for 9-month extension of project.

At the end, A. Kuhar (KIS) reminded that if anyone has any kind of issue or if you need help for the financial or the administrative part, do not hesitate and please send a request or question to the project office on KIS, they will help you.

2.4. WP2 Wheat

Speaker Heinrich Grausgruber (BOKU) - WP2 leader

Heinrich Grausgruber (BOKU) presented the results and progress of WP 2 and its 5 tasks. He began the presentation with Task 2.1: Screening of genetic resources and breeding. Several nurseries were established, out of which the late maturing and early maturing nurseries are most abundant (with around 60 and 80 wheat varieties respectively). He also presented other nurseries of other countries/partners involved in this task. Three preliminary trials for advanced phenotyping techniques to be applied, are currently ongoing at KIS, UNEW and an indoor advanced phenotyping by NPPC and PSI partners.

He presented the spatial analysis of the obtained data from Slovakia, Germany and Romania where some trends were observable, although he emphasized the importance of proper plot randomization lay-out in the field. He showed results of grain yield performance of test sites (Germany, Czech, Slovakia, Hungry, Slovenia, Serbia, and Romania) for late and early nurseries. Romania and Slovenia were severely affected by drought. He suggested that manual weeding should not be performed too often, so that wheat competitiveness or suppression of weeds between the genotypes can be seen, but rather it should be done at the end before the harvest.

He detailly showed the results of relative yield for late nursery. Varieties from conventional programs produced higher yield, however quality analyses data from NPPC are still to be considered, since usually the organic varieties are of better quality. Old landraces/varieties were significantly inferior. He questioned their use and suggested using them for crossing for transferring specific traits, but not for anything else.

Then he presented spring nurseries. Austria had severe drought and high temperatures in spring, producing very low yield. The drought resistant plant material from South Africa, Canada and USA were significantly inferior in yield, but significantly higher in protein content, making it a potential crossing material.

In durum nurseries, the old landrace performed inferior while modern varieties and breeding lines produced the highest yield. Austria had a major problem with the Wheat Dwarf virus which mainly affected Mediterranean germplasm – early maturing, more susceptible. Mediterranean material was also much more sensitive to harrowing, because it is more advanced in juvenile growth at the time of harrowing. Heinrich suggested adjusting or slightly increasing the density since plant height of durum wheat is critical with respect to weed competitiveness.

Advanced phenotyping trials were laid out by two partners (KIS and UNEW) who did preliminary trials to test the equipment, as well as the thermal and multispectral imaging in combination with conventional phenotyping. Both partners also performed digital image analysis for ground cover, where barley was used as a weed imitator – nice genotyping difference, suppression of barley. UNITUS did some advanced phenotyping and screening of durum wheat for drought and salt stress, though data is still being generated and evaluated.

Another advanced phenotyping trial began in March 2021 at NPPC and some seeds were also transferred to Czech Republic for indoor phenotyping of drought stress in common wheat. Altogether 34 varieties (from late and early nurseries) were tested, and all material was divided into 5 maturity classes according to T2.1 field data – stress was not applied simultaneously but according to maturity. Several advanced phenotyping techniques were used: RGB digital colour imaging, kinetic chlorophyll fluorescence imaging, hyperspectral imaging in visible and near-infrared wavelength, thermal imaging, 3D scanning and modelling, NIR imaging.

In Task 2.2 (AMF-compatibility evaluation) both BOKU and UNEW performed pot experiments with a set of 40 varieties selected from all partners, although results are not consistent between BOKU and UNEW. BOKU currently has field trials with selected varieties from this pot experiment, while UNEW is using NGS to identify mycorrhiza species present in “organic soil”.

Heinrich then shortly presented results of Task 2.3 (Allelopathic activity screening) by UVIGO, which were later presented by Adela and Yedra in more detail. UNEW performed a similar germination assay – pot experiment with several weed species to test for weed suppression. There was a genotypic response, although organic varieties did not perform better.

Heinrich then continued the presentation with results of Task 2.4, Marker Assisted Selection for Common bunt resistance. BOKU started with various crosses with resistant lines and several backcrosses, where markers were used for identification of heterozygous plants, which were later used for selfing. First field trials in artificially inoculated experiments were performed in 2021 at BOKU and CRI. Various resistance sources were used for backcrossing, in some cases varieties containing unknown resistance genes with no markers available. Pyramiding of genes was hampered by the non-availability of many molecular markers for several (effective) resistance genes, but resistance can be identified with artificially inoculated field trials. MTA-ATK and NARDI analyzed rust resistance genes (leaf rust, stem rust, and yellow rust), wheat-rye chromosome translocations, plant height, photoperiod response and grain protein content.

In Task 2.5 (Development of new wheat germplasm for organic farming) MTA-ATK multiplied 2 populations and should be possible to go with these two populations to the field in fall 2021. Three Composite cross populations (CCP), evaluated in T2.1, were developed and will be

included in WP6 trials. Twelve CCP were developed by RGA and tested in 2020 in field in Slovenia and Hungary. All partners did over 100 crosses containing only ECOBREED material, and are currently being evaluated by all partners. BOKU did several multiple back-crosses which will be evaluated for maturity, protein content and available to partners as well as common bunt crosses. This task also includes a small program with perennial wheat, mostly done by RGA where 77 best genotypes were selected. BOKU is currently also multiplying the recently released variety of *Thinopyrum intermedium*.

With this Heinrich concluded his presentation and gave floor to Adela Sánchez Moreiras and Yedra Vietes for a detailed presentation of Task 2.3, then to Daniel Cristina for a detailed presentation of Task 2.4.

Adela Sanchez Moreiras presented the screening of 37 out of 40 wheat varieties for phytotoxic potential. The first objective, to elucidate the allopathic effects of wheat secondary metabolites on germination, seedling growth, biomass and photosynthetic pigments, was reached.

Yedra Vietes (UVIGO) presented results of germination, growth bioassays and phytotoxic assays of Task 2.3, which includes two partners; UNEW and UVIGO. She presented results of germination bioassays for both weed species *Portulaca oleracea* and *Lolium rigidum*. Some activities were delayed since germination failed for 9 varieties out of 40 and due to the Covid-19 situation (denied access to university for 4 months, and limited access for another 4 months).

Daniel Cristina (NARDI) presented the MAS (Task 2.4) of early maturity winter wheat nursery (84 genotypes), where several markers for leaf rust resistance, dwarfing, photoperiod, spikelet number per spike, plant height, grain yield, and grain protein content were included. Currently they are screening the remaining plants from the population.

Q&A:

Steven Jacobs (Organic Farmers and Growers CIC) asked what are the yield figures relating to? Tonnes per hectare? To which Heinrich replied it is decidons per hectare, and seed rates were variable according to region 400-500 seeds per m^2.

Steven Jacobs also asked which varieties were used in CCP crosses. Heinrich replied that all varieties included in CCP were described in Reporting period 1, although RGA did not deliver this information.

Monika Messmer FiBL (LIVESEED) asked if they analyzed the AMF species and strains present in both trials, to which Heinrich replied that strains used in pot experiments are known. BOKU has their own isolate, while UNEW is currently applying NGS to identify field strains. BOKU is also planning to use NGS for such purposes.

Steven Jacobs askedwhat soils were the plants in? Clay, loam..? Heinrich replied that different soil was used depending on the region, e.g. German used more loam in soil.

2.5. WP3 Potato

Speaker Peter Dolničar (KIS), WP3 leader

At WP 3 four institutions are involved – KIS, UNEW, IHAR, UP/MATE. Within the WP there are 6 tasks.

Task 3. 1. - Phenotyping trials

We have 65 varieties planted in all countries, in some countries there are a little bit more. In most of locations, except in Poland, we have 3 repetitions of 30 plants of same variety per repetition.

We have separate late blight trials in Slovenia and Poland, part was done last year (2020) and part will be done this year (2021).

In the first year we had quite some problems with establishing the experiments. After that, experiments were done well, except in UK there were some problems with weed.

Some of the best varieties were presented in a table. There is no variety with best performance at all four locations and in all environments. Most of the presented varieties had good performance at least at one location, if not at more. Average yields were highest in Poland, following by yields in Slovenia. In Hungary and at New Castle yields were a bit lower. In general, 3 maturity groups of varieties are included in trials: early, intermediate, and late group of potato varieties.

Late blight is one of the major problems in potato production, especially in organic sector. Our focus is to get the most resistant varieties as possible, and at the same time that the tuber quality is good. In Poland, late blight field trials and detached leaf trials in laboratory were done in first year, field trials will be done Slovenia as well. There are almost 20 varieties out of all 65, that are resistant to late blight. When we compare total yield and marketable yield, we can see that more resistant varieties had higher yield (both yields) compared to susceptible. We can see that resistant varieties with detached leaflet above six exhibit better quality than the rest of susceptible varieties.

Classical phenotyping was done on many traits either during growing season or on tubers after harvest. Protocol determined in the deliverable 3. 1. was used.

Preliminary phenotyping evaluation with multispectral camera was done in Slovenia in 2020 and also in UK for evaluation temporal responses of potato varieties.

In Slovenia and UK remote sensing evaluation in 2021 will start as planned.

Some examples from 2020 were shortly presented – thermal imaging in 2020 from ECOBREED trial in 2020 – negative correlation between temperature and harvest traits was observed, this will be replicated in 2021.

For 2021 data collection is planned at 3-4 time points using RGB and spectral imaging sensors to understand the variability in potato varieties and response to disease detection in Slovenia and the UK.

Task 3. 2. AMF – compatibility screening (UNEW)

There were quite some problems with 1st trial in UK, no colonisation was detected on root samples at the end of experiment. 2nd potato AMF screen was set up in early 2021 using the same list of around 20 varieties, with potatoes harvested from the field in 2020. Protocol was changed a bit, at the moment tubers are planted in 3 litre pots, colonisation assessments will likely take place in June.

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Task 3. 3. Improving seed tuber quality and vigour via the use of cover crops

Cover crops trials were set up in UK and in Slovenia in August 2020.

Species used:

- Brassica juncea (brown mustard) - 10 kg/ha
- Raphanus sativus (oilseed radish) - 15 kg/ha
- Medicago sativa (lucerne) – 25 kg/ha
- Avena strigosa (black oat) – 25 kg/ha
- Vicia sativa (vetch) – 25 kg/ha
- Mixture – 15 kg/ha

In UK all the trials started well, but they had problems with weed, in December 2020 the decision was made to abandon the trial and repeat it on another location next year.

In Slovenia everything went well last year. This year the potatoes are growing well, but the season is quite late.

Task 3. 4. Colorado potato beetle and wireworm control strategies

For CPB experiment was carried on last year (2020) on the same field as phenotyping experiment with variety KIS Kokra. Several treatments were used and effectiveness of individual bioinsecticide was evaluated at the end of experiment.

Spinosat was very effective, but its use not allowed in some countries. Beauverua bassiana and azadirahtin were also quite effective. Effects of various biopesticide treatments were better seen 7 days post treatment, not after 2 days.

Wireworms are causing big problems in potato production. 2 fields experiments were set up in Slovenia in 2020, in both experiments 6 different treatments were used. The first-year results show some differences, but the trials have to be repeated in 2021.

Task 3. 5. Marker assisted selection in organic breeding

At KIS we did a lot of crossing, finished with number of resistant families, a total of 108 berries with seed were produced. In the programme we selected around 20 resistant varieties which are now used for crossing. In Slovenia we selected some crosses from 2011 to 2017, some also from other years. This year they will plant them in conventional and in organic fields.

For couple of years several molecular markers are used for selection of suitable clones for breeding.

At IHAR in 2020 some crossing combinations were planted in the field conditions. 159 progeny clones were evaluated in 2020, mean values of some traits were presented.

In Hungary, they did quite a number of successful crosses between resistant and susceptible parents, they also use molecular markers in selection processes.

Task 3.6. Production of elite varieties and advanced breeding lines

Parental resistant plants are grown in on the brick at KIS. The crosses between resistant parents for production of advanced breeding lines were done in 2020 and will also be done in 2021.

From the crossing year 2017 over 2100 seeds of 12 resistant families were sown and seedlings were produced in 2018. Selected molecular markers were applied at seedling stage and 327 late blight resistant genotypes with at least 2 R genes (late blight or PVY) were selected in years 2018 and 2019. 92 of them were selected on the field in 2020. We have good material for future work.

IHAR

Amon cultivars from working collection group of cultivars resistant to late blight were identified, its resistance is most probably provided by R genes. To efficiently applied marker assisted

selection in progenies of these cultivars R-genes as well as DNA markers linked with these genes have to be identified first. Publicly available information about identified R-genes against late blight and DNA markers was collected. The screening of cultivars for working collection for presence of specific DNA markers is currently ongoing.

UP/MATE

For selecting advanced breeding lines with combined resistance against PVY and late blight several clones were planted in the breeding burden and scored for disease symptoms, yield and cultural traits under natural infection conditions. All the most advanced lines (C and D clones) were evaluated for wart and nematode resistance under artificial infection conditions.

All advanced lines showed extreme resistance to PVY, while several were proved to be resistant to wart and G. rostochiensis nematodes as well. Late blight resistance of tested genotypes varied between scores 2 to 8. Best genotypes based on combination of wanted characteristics were selected for further evaluation in 2021.

Summary of WP3

In the reporting period of WP 3 most of the activities went according to plan. The experiments for phenotyping were performed at four locations (HU, POL and UK) in 2020. An agreed list of descriptors was used for assessment of morphological and phenological characteristics.

UNEW carried out a potato variety AMF compatibility screen (T3.2). A 2nd potato AMF screen was set up in early 2021 using the same list of varieties but with potatoes harvested from the field in 2020 and soil from the 2020 potato trial at Nafferton Farm was used.

T3.3 - The trials in 2020 established well, but in UK trial was soon overrun with charlock. A decision was taken to abandon the trial and instead to run in the following 2 seasons 2021-22 and 2022-23 on a different field. In Slovenia trial with 4 potato varieties was set up in April 2021 as planned.

One Colorado potato beetle trial and two wireworm trials were set up in Slovenia in 2020 (T3.4) using different bioinsecticides and their formulations. Trials were evaluated and harvested as planned. Colorado potato beetle trial in Hungary failed due lack of CPB on crops.

Marker assisted selection in organic breeding (T3.5) started as planned at all three breeding stations in Slovenia, Hungary and Poland. There were successful crossings with late blight resistant parents performed and progenies from pre-project years evaluated on the fields. Molecular markers were applied at the selection In Slovenia organic selection site was established in 2021.

Task 3.6 - Production of elite varieties and advanced breeding lines there were successful, crossings with late blight and PVY resistant parents were made. In Slovenia and in Poland advanced genotypes from previous years were evaluated.

WP3 – Milestones' overview

MS8: Multiplication of potato seed for FPT and breeding activities and seed sent to partners was fully achieved.

MS18: Order of cover crop seed for seed multiplication evaluation was fully achieved with two-month delay, which did not affect the fulfilment of the Task 3.3.

MS42: Selection of potato varieties to use in FPT and start of seed multiplication was fully achieved, farmers already started with FPT.

MS45: Establishment of segregating populations for specified traits was fully achieved by all three partners producing late blight and PVY resistant families.

2.6. WP4 Soybean

Speaker Kristina Petrović (KIS), WP4 leader

Kristina Petrovič (IFVC) presented WP4 activities for the past year. All activities were done according to the plant without any delays, there were no deliverables for this period and all milestones were achieved. She reported that Greek partner left the consortium.

Vuk Djordjević (IFVC) presented main achievements during Year 3 in Task 4.1. The main goal was identification of useful traits of soybean in the established network of 3 locations, Austria, Serbia, and Romania. He presented results from two locations (Austria and Serbia), since Romania had some difficulties: high infestation of pests, heavy rain at the beginning of the season and severe drought late in the season.

Vuk started with first year results where 30 soybean traits over the set of 206 genotypes at 2 locations were scored. He showed an example of canopy cover and phenology in early and late trial.

He continued presentation with reactions of soybean varieties or evaluation for tolerance to *Nezara viridula* (Southern green stink bug). They completed the third year of screening of soybean genotypes. Vuk showed a table of 2020 field trial results effect of the *N. viridula* on soybean yield. Early varieties had up to 100% damage, although some genotypes showed some degree of tolerance – can be used for breeding.

Vuk presented screening of genetic resources to the competitiveness against weeds that are difficult to control by mechanical measures in organic production. He continued with results of how much of the yield and production is lost due to weed competition, canopy cover and competition with these weeds – hyperspectral aerial images. The plan is to repeat this trial next year.

Last activity in this task is evaluation of soybean genotypes for resistance to charcoal rot (*Macrophomina phaseolina*) and stem canker (*Diaporthe caulivora*). Several genotypes were tested, some of them showed different reactions.

Plan for Year 4 is to continue with trial (two-year screening of germplasm over these three locations), data analysis, working on sample collection and quality – lab analysis of protein and oil. The plan is also to perform seed vigor analysis and continue with biotic stress (insects, weeds, disease) trials and data analysis.

In Task 4.2 abiotic stress trials were performed at 3 locations: SZG (Austria) – chilling tolerance, pigeons destroy trial, NARDI (Romania) – chilling tolerance, good start, problems with drought, IFVC (Serbia) – drought tolerance, data collected. Vuk showed results of these trials. For drought tolerance a whole set of 206 varieties, from task 4.1, were screened with multispectral imaging (well-watered and drought stress field). Plan for the Year 4 is to continue with trials in 2021, data

analysis especially with multispectral imaging – almost 1 TB of data of aerial images, as well as quality analysis (protein, oil).

Johan Vollmann (BOKU) presented main achievements during Year 3 in Task 4.3 (Nitrogen fixation). Since N fixation cannot be monitored directly, he presented the setup – phenotypic data from field experiments coupled with hyperspectral reflectance at visible and IR wavelength collected at the same time. This combined data can be used to predict nitrogen fixation or related traits. Over 95 different varieties of soybean were used, grouped in five genotype classes in three environments. Johann showed a relationship between the SPAD meter measurements and seed protein content at maturity – differentiation between these five genotype classes can be seen. Results of hyperspectral reflections at different wavelengths, sucrose and seed protein content were negatively correlated. Johann then listed published spectral reflectance indices, which were selected based on their potential relevance for soybean nitrogen metabolism, water use and general biomass formation. High precision strategy was used (400 individual chlorophyll measurements per plot) to obtain high precision results. Several indices, which are behaving stable / reproducible and correlated to classical traits (grain yield, seed protein, …), were identified.

Marina Čeran (IFVC), Task 4.4 leader, presented the main achievements and activities for soy genotyping. The main activity in Year 3 was screening of soybean germplasm and evaluation of potential parents and breeding material for cadmium accumulation, supernodulation and disease tolerance.

BOKU and NARDI screened a total of 27 soybean genotypes for cadmium accumulation. SSR molecular marker associated with major QTL and gene based dCAPS marker were used. 11 lines had allele for low Cd accumulation, which is desirable in soybean in organic production, and 6 of those also had high yield which was determined in Task 4.1.

For supernodulation SNP marker was used for genotyping at NARDI. All tested genotypes were heterozygous and therefore not supernodulating since supernodulation is a homozygous trait. This is expected since according to literature supernodulation can mainly be achieved artificially using mutants.

For disease tolerance / partial resistance to *Sclerotina Sclerotiorum*, quantitatively controlled by several QTL, GWAS was performed to search for potential markers. 17 significant SNPs were identified.

For Northern stem canker (*Diaporthe caulivora*) a similar approach with GWAS was performed to search for markers associated with resistance. Phenotypic data were presented as the percentage of dead plants, from Task 4.1. Altogether 15 SNPs were identified and varieties Favorit and Jelica had most of these alleles for resistance and can be used as potential donors in breeding.

For Southern stem canker (*Diaporthe aspalathi*), a single major gene gives resistance on chromosome 14. Marker data for these selected SNPs were used to find possible sources of resistance in material from the ECOBREED project. Altogether 13 lines were identified with allele combination that is characteristic for resistant individuals.

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Marjana Vasiljević (IFVC), leader of Task 4.5, presented the main achievements for Task 4.5. This task includes 4 partners (Greek partner left the Consortium). Focus of this task is importance of seed inoculant use, effect of micronutrient coatings and recommendation for further use of cover crops. All activities were done according to plan, regardless of Covid-19 epidemic. Two trials were set up at 4 locations in total.

Marjana first presented the inoculant trial at Novi Sad. Protocols for trial, selected treatments, and analysis of seed material after harvest were shared with partners. In 2019 preliminary trial was performed, where results were used as the basis for field trial in 2020.

The cover crop trial took place in 2019, where two cover crops were selected: single (rye) and mixture of two crops (field pea and oat). In April 2020 sowing of soybean was done and two soybean varieties were selected according to soybean genotypes used in task 4.1. Global Seed did the preliminary trial using the same protocols and design – two cover crops, two soybean varieties in 4 replications. After harvest in 2020 they did protein content analysis, seed health and soil analysis. Morphological traits were measured as well.

SZG (Austria) did the inoculant trial with 8 treatments, 2 soybean varieties and 2 replications. The trial was manually sown for preventing cross contamination and weeds were suppressed manually. Marjana presented results from these trials. The main conclusion was that seed inoculum achieved the best yield result and protein content is more influenced by variety. Despite these results, they had difficult soil conditions in the trial, heavy rainfalls and silting during the vegetation period.

Plan for Year 4 is to continue with collection of results and their analysis, continuation of trials with cover crops and inoculants at 4 locations in 2021. Establishment of the inoculant trial was already done in April 2021 (SZG, IFVC). Results will be published and one practical abstract for seed inoculation and one for cover trial will be prepared.

Maria Bernhart, leader of Task 4.6 presented the main activities. Main breeding activities were shifted to later months of the project since this task is building on results of other tasks. In 2019, first crosses were made in SZG and IFVC of genotypes with traits beneficial for organic production (branching behaviour, good soil coverage, etc.). In 2020 they generated and grew the F1 plants at SZG and IFVC, with hybridity tests performed as well as harvest. In 2021 they will continue with the segregating population, 6 populations with different maturity, adaptability, yield and quality potential. Based on the results of Task 4.1, genotypes used for crosses will be selected this year. Plan for 2022 is to include the segregating populations in WP6 participatory farmers' fields as well as breeding and selection at farmers' fields.

Q&A:

Steven Jacobs (Organic Farmers & Growers) asked if the soil organic matter was measured, since it can have a big impact on drought tolerance. Vuk replied that they did measure it, on the same field (well-watered and drought conditions). Vuk explained that the problem with drought tolerance is they do not have drought every year and it is important to constantly find drought locations. Sandy soil can be used as a surrogate for this.

Monika Messmer (LIVESEED) asked if they found an easy measurement for N fixation that could be used for breeders or do, we have to use complex methods, whole spectrum analysis of big data. Is the protein content sufficiently good as a target of N fixation? Johann replied that they focused on protein content because it is a key trait and end product of the whole process. As for the measurements there are alternatives, but they specifically wanted to find out what can be done with the whole spectrum. For N fixation and protein content cameras are available with narrow wavelength range to put on the drone and get the info you need.

2.7. WP5 Buckwheat

Speaker Dagmar Janovská (CRI) – WP5 leader

8 partners are working on this WP(KIS, UVIGO, UNEW, Cri, RGA, SZG, WSU, CAAS), WP covers 3 continents (USA, China, Europe) that includes 5 tasks.
Main objectives are:

- Identifying genetic variation in agronomic and nutritional traits for development of elite varieties suitable for organic production
- Identifying genotypes with increased allelopathic activity
- Screening buckwheat varieties for P mineralization capacity
- Performing crosses

T5. 1. Screening of genetic resources and breeding material (M 12-60)
Objectives:

- Extensive phenotyping in the field trials in 4 countries
- Extensive phenotyping in CN
- Analyses of selected compounds
- Selection of 96 accessions for T5.4 for genetic diversity analysis using molecular markers

Last year we changed some descriptors and added photos for some descriptors since they were a bit confusing. We selected 29 traits which we evaluate according to same descriptors, we will analyse selected compounds.
Results:

- Same design in AT, CZ and SI
- Same set of common 54 genotypes
- Additional genotypes at each country together 323
- US - same design, same set of common 54 genotypes

Some results were presented – the differences between Austrian and Czech evaluations – height, number of flower clusters, number of seeds, the thousand seed weight from 2019 and 2020. These traits are the most important for calculation of yield potential of different genotypes. Another results from laboratory analysis from 3 countries were presented - crude protein content, antioxidant activity, total phenolic content, total phenols and the content of 20 phenolic compounds. There are a lot of differences between genotypes and also years.

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Work done in CAAS

Speaker Kaixuan Zhang (CAAS)

For the evaluation of 1,287 common buckwheat accessions 3 localities were selected – Beijing, Yunnan and Hainan in 2020 and 2021.

Phenotyping was conducted using the same design at all locations. 9 agronomic traits and 2 quality traits were evaluated, including leaf shape, flower colour, seed shape, growth period, plant height, 1000 grain weight, pericarp colour, total flavonoids and rutin content. There are 4 different types of leaves, light and dark pink colour of flowers and 2 types of seeds. Most phenotypic traits exhibit great variation in different buckwheat germplasm resources. Rutin content has the greatest variation off all the traits they have evaluated.

Slight delays were experiences with laboratory analyses because of COVID-19 limitations and restrictions for work.

T5.2 Allelopathic activity screening (M 12-48)

Speakers Adela Sánchez Moreiras and Iftikhar Hussain (UVIGO)

There were many problems in the beginning with germination, but they solved them and continue to work within plan.

Objectives

- Elucidate the allelopathic effects of buckwheat secondary metabolites on germination, seedling growth, biomass and photosynthetic pigments of target weed species, the monocot *Lolium rigidum* L. (Gaud), and the dicot *Portulaca oleracea* L.
- Identify and quantify polyphenols (phenolic acids and flavonoids) metabolic profile by LC MS/MS; compare their abundance in selected buckwheat cultivars, and relate this abundance with the allelopathic potential of the different cultivars.

Methods for germination and growth bioassays and for pigment's identification on HPLC were presented. Biometric parameters that were evaluated were germination, radicle length, total plant weight and leaf chlorophyll pigments.

Results

Germination and growth bioassays

Kora is the most inhibitory variety against germination and growth of *P. oleracea*. In contrast, buckwheat seems to stimulate the growth of this weed, as seen with varieties Harpe, Sarasín a Ployes, Westwod Ican, Jianzui, PI481671 and PI476852.

Gema seems to be the most promising variety against *L. rigidum* due to its ability to inhibit germination and biomass. Followed by varieties Westwood Ican, Harpe, Eva, Kora and RCAT 068749.

Pigment's identification

Lolium rigidum: Highest reduction was obtained in neoxanthin (98%/97%), followed by chl b (63%/60 and lutein (48%/41%) by PI481671 and GEMA.

Portulca oleracea: Highest reduction was obtained in neoxanthin (96%) and lutein (68%) when *P. oleracea* was grown in association with PI481671.

Delays

- Problems with seeds contamination by fungi

- The COVID-19 crisis delayed the germination and growth bioassays, and especially the chemical analyses, as the access to the University was forbidden for 4 months due to severe lockdown and quarantine situation that remained for several months in Spain. Actually, after those 4 lockdown months, the working rhythmus was very slow for another 4 months because the authorities of the University limited to one person the access to the laboratories.
  - Lack of perlite (inert substrate) due to delays in transport caused by COVID-19.

T5. 3. Screening for genetic variation and P-mineralization (M 12-54)

Speaker Gabriela Mühlbachova (CRI)

Objectives

- Field experiments in 3 countries – CZ, SI and US
- Characterisation of buckwheat varieties (10 common buckwheat, 1 Tartary buckwheat, in CZ additional variety Zamira)
- Analyses of P content in soil samples as well as in biomass and grains
- Assessment of bioavailability of P for following crops

Results

- Results in 2019 and 2020 showed differences within buckwheat varieties of their ability to
  - mobilize phosphorus for uptake
- 12 varieties grown in field trials showed different growth, P content and P uptake.
  - Good phosphorus contents and P uptake were shown by the variety La Harpe in 2019 in the Czech Republic and in Slovenia also in 2020.
  - The variety Zamira showed the best growth, P content and P uptake under more regular precipitations in 2020 (only Czech Republic).
  - In contrast, the variety Hruszowska showed one of the worst results in terms of P content and uptake by plants.
- Possibly, weather conditions (distribution of precipitation) play an important role in the ability of buckwheat varieties to mobilize phosphorus.
- No significant correlation was found between soil P content and P content and uptake in buckwheat.

There were slight delays with laboratory analyses due to COVID-19 restrictions.

T5.4 Genotyping (M 13-36),

Speaker Kaixuan Zhang (CAAS)

Objectives

- Genotyping to identify underlying genetic response to abiotic and biotic stresses together with quality traits
- Optimization of method
- Using of markers for selected Chinese and European accessions

We used the accessions that were evaluated in task 5. 1.

Results:

- The 1287 accessions were clustered in five groups by using SSR molecular markers, which was correlated with their geographical distribution.
- Combining phenotypes and SSR markers, 530 accessions were chosen as a primary core collection of common buckwheat.
- The genome of *Fagopyrum homotropicum,* wild relative of common buckwheat, was *de novo* sequenced
- A high quality, chromosome-scale reference genome sequence of 1023 Mb is assembled on 8 chromosomes

There were some delays experienced. 500 accessions have been under the progress of the whole genome resequencing. Due to the restrictions of COVID-19 the shipment of DNA from Europe to China was delayed. Resequencing could be finished until August and hopefully analyses will be finished, and the results will be published before the next meeting.

T5.5 Production of elite varieties and advanced breeding lines (M 13-60)

Speaker Dagmar Janovská (CRI)

Objectives

- Enhancement of the yield performance of common buckwheat crosses between and within common buckwheat and self-compatible species of *Fagopyrum* genus.
- Development of heterotic synthetic buckwheat varieties.
- Determine the level of heterosis that can be exploited in the given „gene pool" of common buckwheat.

The use of wide crosses for the improvement of buckwheat fertility:

- The aim of wide crosses is to improve the fertility by increasing the proportion of flowers that lead to grain formation
- To overcome the natural barriers which are related with the incompatibility of common buckwheat dimorphic flowering system (pin and thrum type of flowers) we decide to introduce self-compatibility gene (S_h) of *F. homotropicum* into elite common buckwheat germplasm

Heterosis breeding with the creation of synthetic varieties:

- Since common buckwheat is self-incompatibility plant species it is impossible to create the pure lines and express male sterility, two main conditions essential in the development of highly heterotic F1 hybrids
- The alternative way to exploit the heterosis genetic phenomenon is the development of common buckwheat synthetic varieties

Results

- In 2019, 257 crosses of 125 combinations leading to 4,372 harvested seeds in RGA
- In 2020, 55 selected combinations were evaluated and compared with parental genotypes in RGA
- Based on the results which were recorded in the experimental F1 crosses we assume that the MPH values in the synthetic progenies can exceed also 10%.
- With the aim of introducing the trait for improved fertility into the common buckwheat germplasm, RGA performed 58 experimental crosses between accessions botanically belonging to *F. esculentum*, *F. tataricum* and *F.homotropicum* in 2020.

- The introduction of a self-compatibility gene (S_h) of *F. homotropicum* into common buckwheat germplasm seems to be more promising in terms of developing self-compatible buckwheat lines.
- In 2020, 89 seeds from 3 combinations harvested in SZG
- Activities will be repeated in 2021

There were no delays in T5.5.

WP 5 Milestones and deliverables overview
MS 28: Genotyping of buckwheat collection completed (M36)
MS 34: Multiplication of buckwheat seed for FPT and breeding activities (M36)
MS 35: Establishment of segregating population for specified traits (buckwheat) (M36)
MS 43: Selection of buckwheat varieties to use in FPT and start of seed multiplication (M24)
Deliverables: No deliverables.
Dagmar thanked all partners for well done work by now and for smooth collaboration.

Invitation for buckwheat symposium, which will be held online in September.

Questions
Question 1 (Monika Messmer (LIVESEED)): Will the allelopathic effects of different buckwheat cultivars will be correlated to the various compound in the seed and is it possible that some of the compounds that result in allelopathic effect could have a antinutritiounal or taste effect?
Answer 1 (Adela Sánchez Moreiras (UVIGO)): Yes, it will be interesting to study the relation of those results in the future.

Question 2 (Monika Messmer (LIVESEED)): Did you test under different soil level of phosphorus in the same field? Was phosphorus a limiting factor for buckwheat growth? Why were different P extraction methods used?
Answer 2 (Gabriela Mühlbachova (CRI)): We studies soil profile from 0 to 30 cm. Method for determination – all methods are suitable, but each is giving different results. Method that is used in Czech Republic is standardly used for soil system in Czech Republic. I use this method despite the fact that it has some limitations for determining phosphorus, but it gives potential of bioavailability of nutrients, including phosphorus, from soils. To see more available fractions other extractions were used. Water was used on fresh soils, this is used in Czech Republic because to get fresh samples from distant location is a bit difficult. For samples from distant locations, for example from Slovenia, method for determining exchangeable fractions was used.

Question 3 (Monika Messmer (LIVESEED)): Did you have the same field phosphorus levels and if P was limiting factor for plants?
Answer 3 (Gabriela Mühlbachova (CRI)): No, I think P was not limiting factor for plants, because the differences were not so great. According to method which shows potential, it seems there is enough phosphorus in soil, samples were taken 2 per year from one field. In different years soil from different fields was sampled, different fields were also used for spring and summer sowing.
Comment (Monika Messmer (LIVESEED)): It would be really difficult to find something about phosphorus use efficiency, if the phosphorus is not at minimum on your trial fields. We had

similar problem in Switzerland, it's difficult to find soil that have low P content. Way may be to look for farms that do biodynamic farming, because usually these are the ones that are quite low in P, which might be really useful for future work to better see differentiation how the plant react to minimum P.

Comment (Dagmar Janovská (CRI)): We have in plan field trials this year in the WP 6 – Farmer participatory trials, where we will also collect soil samples and biomass and we will analyze P content to see if there are also differences. We have different locations in CZ, as well as in Slovenia and UK.

Question 4 (Mario Augusto Pagnotta (UNITUS)): Why do you want self-compatible? I would be much easier perform crosses in self-incompatible.

Answer 4 (Dagmar Janovská (CRI)): Yes, it would be much easier to perform crosses in self-incompatible plants, but we would like to create inbred lines, so we need to transform self-compatible to self-incompatible varieties or genotypes.

Question 5 (Steven Jacobs (Organic Farmers & Growers)): I'm not clear what is meant by synthetic varieties?

Answer 5 (Dagmar Janovská (CRI)): It is terminus technicus and it means that you have several parental lines in one variety, and you choose from this variety.

Question 6 (Mario Augusto Pagnotta (UNITUS)): Did you try with double haploid?

Answer 6 (Dagmar Janovská (CRI)): It's on the edge of techniques for organic breeding, so we have not used this technique.

2.8. WP6 Farmer Participatory Trails and Breeding

Speaker Werner Vogt-Kaute (NATUR) – WP6 leader

Task 6.1. Data recording and management system

Because of a cyber-attack at Newcastle University data management system was not available from October 2020 to March 2021. Since April it is available, but some data were lost and had to be input again.

Task 6.2. Farmer participatory field trials (M 25-48 = harvest years 2021 and 2022)

Responsible partner: NATUR, partners involved: all except UVIGO, SZG, SEC, (SEL), Saatgut Austria. In some cases, 2 partners in 1 country are involved.

The FPT are established. We have 62 farms with 71 trials, including 3 farms in US. Total number of cultivars (but not different ones): 689. Few farms with less than 8 varieties, on average 10 varieties per trial.

EL left the project and the FPT had to be distributed to other countries

- Wheat: UK, RS/IT, AT, SK
- Buckwheat: UK, CZ, SI
- Potato: PO, HU, SI
- Soya: DE, RS, RO, AT/SI

Some additional trials. Samples of harvest to BOKU (wheat), CRI (buckwheat), KIS (potato), IFVC (soybean).

2020 wheat pre-multiplications at SMA and PRO-BIO were very successful. Enough seed and first evaluations.
2020 some pre-trials: Buckwheat in CZ and potatoes in PL, SI, DE. First field visits with farmers (often limited number because of covid 19 restrictions).
2021 first trials with seed treatment started in the UK. More trials must be done next years. Best crop for the seed treatment trials is wheat. Video conference in summer.

Task 6.3. Participatory plant breeding (months 25 60 = harvest years 2021, 2022, 2023)
Cross composite populations (CCP) of wheat, buckwheat and soybean. Small number of potato breeding lines for evaluation to farmers in 2022.

- Total number of farms that have sown CCPs: 18
- Total number of CCPs: 25
- Wakelyns: 4 (UK)
- Liocharls: 3 (UK, AT)
- 1109: 1 (UK)
- Mv elite CCP: 14 (AT, SK, HU, RS)
- Mv Bio2020: 3 (HU)

Distribution of CCPs of soya (IFVC) and buckwheat (RGA) must be postponed to April 2022 to have more seed.

Meetings and field visits
The big events are part of WP7 (training) and WP8 (demonstration) but of course you need meetings/field visits with farmers and stakeholders at every FTP. Please document the meetings and make photos.

2.9. WP7 Training

Speaker Mario A. Pagnotta (UNITUS) – WP7 leader

WP7 activities are not equally distributed along the project between partners.
Due to COVID-19 situation many events and activities were cancelled or postponed, and some deliverables were not met as it was planned. Advantage of online events is that more participants can attend.

T7.1 Advanced genotyping training (M 7-48)
4 workshops (5 days/ 12 participants):

1. Association genetics and marker assisted breeding,
2. QTL identification for MAS,
3. Applications of transcriptomic,
4. Proteomic methods/approaches in crop breeding,
5. Bioinformatics

Locations:

- UNITUS – Italy
- BOKU – Austria
- IFVC – Serbia

- NPPC – Slovakia

BOKU prepared a summer school on "Digital Breeding", topics: Genome selection and Digital Phenotyping, that was planned on 2-8 August 2020 and is postponed to summer of 2022.
BOKU prepared the XXI International Workshop on Bunt and Smut Diseases. **Tasks 7.1 and 7.2** an online event scheduled for 5-6 May 2021.
UNITUS have organized an "advance genotyping training" course in Viterbo (Italy) 21-25 June 2021. Registration is open: **http://www.unitus.it/it/dipartimento/dafne/ne/articolo/training-course-on-advanced-genotyping**

T7.2 Advanced phenotyping training (M 7-48)
6 workshops (2 days/ 20 participants):

1. Phenotype traits and GxE interaction,
2. Automatic Phenotype technologies,
3. Results interpretation,
4. Qualitative *vs* quantitative traits,
5. Digital, thermal and hyperspectral imaging,
6. Biostatistics informatics

Locations:

- NPPC – Slovakia
- UNEW – UK
- KIS – Slovenia

NPPC prepared a workshop with BIOMILA spol. s r.o. Wheat market, selection, and registration. November 6, 2019. There were 67 participants.
NPPC organized a workshop on phenotyping and remote sensing. Held in Nitra, Slovakia. January 30, 2020. 14 participants.
NPPC phenotyping training event held on 24-25 May 2021. 249 people registered.
UNEW-KIS training in Nafferton Farm (UK) the 15-16 July 2021 and in 2022 on potato and wheat phenotyping.

T7.3 Participatory Plant Breeding (PPB) training and the organization/management of Farmer Participatory Trials (FPT) (M 7-48)

Farmers where FPT are located will be used to host training activities, 24 workshops (1 days/ local participants):

1. PPB and the organization and management of Farmer Participatory field trials,
2. Concepts of selections in autogamus vs allogamus vs propagated crops,
3. Practical phenotyping selection,
4. Broad adaptability and GxE interactions,
5. Apply breeding and agronomic methodologies/approaches,
6. Enhance seed production efforts,
7. Development of diverse, locally adapted plant populations*, In situ* (on farm) conservation to improved resilience.

Locations. NATUR-Germany, ~~WSU USA~~, UNEW UK, NPPC-Slovakia, ~~GEO Greece~~, KIS Slovenia, BOKU Austria, CRI Czech Republic, IFVC Serbia, IHAR Poland, UP Hungary.

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BOKU meeting on 18 February 2020 with the advisor for organic farming of the Agricultural Chamber of Lower Austria. It was agreed to integrate a training event on Participatory Plant Breeding and development of CCPs for Austrian organic farmers into ongoing activities within ˝Bionet˝, an Austrian educational project between scientists, advisors and farmers for the transfer of knowledge to Austrian organic farmers.
UP (renamed Szent Istvan University) plans meetings on potato in 2021 and 2022. Difficulties in finding farmers interested in organic potato production.
NATUR planned event on organic plant breeding, seed multiplication, composite cross populations at Dottenfelder Hof, Bad Vilbel in June 2021 and a second event on organic plant breeding, seed multiplication, composite cross populations in 2022.

Risks

- Bursaries will be available (500 euros per person for Task 7.1 and 200 euros per person for Task 7.2 for 50% of the places in both tasks) to support travel and accommodation costs for participants from countries outside the consortium within Europe where the organic sector is low and/or where participants have insufficient funds available to attend the workshops.

2.10. WP8 Demonstration, dissemination, exploitation and communication

Speaker Antoaneta G. Kuhar (KIS) – WP8 leader

Progress report of year 3: Work on WP8 is progressing, limited opportunities for dissemination, publications are still not that many, a very good overall coverage on local and social media.

Plan of Exploitation and dissemination of results (PEDR) was submitted in January 2021 and provides KPI to support impact and ensure efficient use of resources, will be regularly updated. Demonstration events (Task 8.4) should effectively involve potential end users of innovative project results. 2nd set of Practice Abstract submitted (BOKU), 1st still not approved (NPPC).

Expectations

- Feeding the social media account: minimum posts/per year/per partner
- Dissemination activities: conferences, workshops, congresses (inform in advance, permission might be needed, costs eligibility)
- Practice abstracts: each Task leader provides at least one
- Each partner should write 1 informative or promotional article signed by an author to be published in a local newspaper or broadcasted through radio or TV
- Each partner prepares report on dissemination and communication activities every 3 months, send them to Antoaneta Kuhar (KIS)

Expectations (publications)

- the publication list is still quite limited impact
- correct EC disclaimer - financial fines!
- gold or green open access - financial fines!
- publications and underlying data should be deposited in open access zenodo

- balance between publication of scientific results and the protection and exploitation of the IP: IP sub-committee

If you have any questions or do you need help, please just ask Project office at KIS.
We have ECOBREED webpage, tweeter account, Facebook page and from recently also you tube channel, on link: **https://www.youtube.com/channel/UCw0toEUHNfYBSwkU3OlNDDA**
Please, visit it and if you have any suitable recordings, you can send them to Project office at KIS and they will upload them on our YouTube channel.

IP

Task 8.3. Exploitation activities

Reached

- In January 2021 IP Sub-committee distributed 2 sample agreements: Material Transfer Agreement (MTA) and Trademark Licensing Agreement. In the reporting period 1 MTA was signed.
- By the end of April 2021, the project partners have drafted consortium and individual exploitation plans included in the D8.2 Interim Plan for Use and Dissemination of the Foreground.

Planned

- In June 2021 IP Sub-Committee will distribute individual exploitation plans to all partners to report on any progress made in the field of IPR protection of project results.
- In July 2021 project partners will receive additional questioner dedicated to business planning.
- In December 2021 finishing the business cases for relevant project partners and starting preparations for negotiations and first draft of the Exploitation Agreements.
- Starting in 2022 continuing negotiations and finalizing the Exploitation Agreements between relevant project partners. We plan to have 4 agreements, one for each new variety.
- In 2022 negotiations with project partners on licensing the Ecobreed TM.
- In 2022 project partners reporting on IPR protection of project results.

IP Sub-Committee

Activities report and plan

- In July 2020 – 2nd annual meeting of the IP Sub Committee. Agenda: Overall progress report and plans for the Y3.
- Submitted 2nd IP exploitation report (month 25)
- Interim meeting in December 2020. Agenda: confirmation of MTA and Licensing Agreement.
- July 2021 - 3rd annual meeting of the IP Sub-Committee.
- In July 2021 preparation of the 3rd IP exploitation report (month 37).

Task 8.4. Demonstration events (M 25-48 = harvest years 2020, 2021, 2022)

Responsible partner: NATUR, partners involved: all, except UVIGO, GS, NARDI, Saatgut A.
Based on the projects field trials, but other locations are also possible.
First demonstration event in SI July 2020. There a not a lot of training events on the webpage yet (SI, DE and HU). Be aware of using the official templates (deposited in intranet).

Vladimir Meglič (KIS), coordinator: I would ask everyone if anything was not clear, please send us a note what needs to be done and how it needs to be done, and we will help you out, since we are getting into the second part of the of the project and it is going to be more and more important to show what we are doing, how we are doing and in how our results are getting even to the end user.

2.11. Scientific Advisory Group: observations and recommendations

The members of Scientific Advisory Groups (SAG) presented their feedback and recommendations regarding the execution and activities of the ECOBREED project.

Monika Messmer (LIVESEED project)

Monika Messmer commented that she is very impressed with work done in all crops, especially during Covid-19 epidemic and the amazing amount of phenotyping and genotyping as well as a large number of traits. She was particularly impressed with very interesting results of allelopathic effects. Monika informed that the organic heterogeneous population (CCP, buckwheat populations) will be possible to spread with farmers from 2022 and delegated act has been recently published.

She was pleased with various breeding material included in the project, many of them already in advanced generation and encouraged everyone to discuss with the examination office on temporary experiment for organic varieties suitable for organic production. This will start either in December 2021 or January 2022, depending on crop variety.

Monika complemented the impressive number of farmers (farmer participatory) and genotypes that will be tested on-farm across Europe – very important for the fast uptake of new cultivars.

She was also impressed by the extensive training program and will happily forward the info on training across LIVESEED and ECO-PB (European Consortium for Organic Breeding) partners. She emphasized the importance for everyone involved in material exchange to look for the MTA (Material Transfer Agreement). She shared her experience with exploitation key results, where they contacted Booster service to help develop business plans (lean canvas), which was very helpful. Monika also commented on the ECOBREED trademark. To her knowledge, Bioverita is the only trademark associated with products derived from organic plant breeding.

She complimented the close exchange on GWAS and MAS data on bunt and winter wheat between LIVESEED and ECOBREED. Although different sources of resistance are integrated in different breeding material, a common set of markers were used at the end of both projects. Helpful exchange on methodologies and statistics for implementing participatory cultivar testing and plant breeding, including common work on databases, is always welcome. LIVESEED is presently exploring a collaboration with SEEDlinked. She presented the exchange of different approaches on organic plant breeding, specifically on decentralized Participatory Plant Breeding including farmers and value chain partners – deliverable for LIVESEED, booklet Guidelines for organic on-farm cultivar trials. ECO-PB as a partner of LIVESEED wants to create available documentation (training, webinars, online lectures) related to organic breeding. Monika presented common conferences between LIVESEED and ECOBREED, and their exchange on

policy recommendations on organic seed and breeding. She emphasized the importance of joint communication and support of sister project on social media and newsletter. Lastly, she presented the special issue between LIVESEED, ECOBREED and BRESOV in MDPI Sustainability on Breeding and Seed Sector Innovations for Organic Food Systems open now until January 2022, with editors Vladimir Meglič, Monika Messmer and Ferdinando Branca.

Q&A:

Heinrich Grausgruber requested to keep him updated on regulations of heterogeneous material. Monika shared a link to the published delegated act through the chat.

Ferdinando Branca (BRESOV project)

Ferdinando Branca complimented that although a lot of work was affected by Covid-19 epidemic, a lot of results were still obtained. In his opinion the ECOBREED project is going in the right direction, while covering some gaps that arise in the project. He complimented the interesting progress for all WPs, which will interest the stakeholders for further exploitation of results. Ferdinando particularly emphasized the importance of cooperation and to reinforce collaboration. He encouraged all participants to continue with all the work and result analysis and suggested reaching out to all stakeholders of all three projects, to increase the audience of all activities and results, since all three projects have the same goal. Several topics overlap between 3 projects, if connected the diversity of studied crops can be increased. He suggested a workshop with ECOBREED together with BRESOV, since BRESOV already had an interesting workshop on tomato with LIVESEED. Each of these events was followed by more than 150 participants. He commented that in training much more collaboration is needed. In BRESOV they postponed the training course. All events and deadlines need frequent and regular notifications, more influx of information. Ferdinando also mentioned that methodologies for genotyping and phenotyping still apply even though all three projects deal with different crop species. He suggested focusing on Temporary experiment for organic varieties suitable for organic production; this organization is ongoing, ECOBREED should implement the interaction with this network. He also mentioned the deadline at the end of July for Abstract submission for the international symposium on organic agriculture, which will be held next December as webinar, and encouraged to present latest results in this context. Lastly, he congratulated all members of the ECOBREED project on all their efforts.

Carlo Leifert (Southern-Cross University, Australia)

C. Leifert lost internet connection and could not present his impressions.

Steven Jacobs (Organic Farmers Growers & CIC)

Firstly, Steven Jacobs introduced himself to the Consortium since this was his first meeting. The Organic Farmers and Growers works in the UK as the organic control body and certifies around half the organic land in the UK and around third of organic businesses. Their focus is the cereals. He emphasized that in the UK, the jump from non-organic to organic in cereals is more challenging than in livestock. Projects like ECOBREED can help in the UK to spread organic production in the areas where livestock is predominant. The organization is particularly interested in evolutionary and participatory plant breeding. He encouraged involving farmers in the project as much as possible although it is tricky. In the UK, there is the need for organic plots, but there is also large variability across these plots. Steven explained that instead of plots in the field you have a strip of a crop variety the length of the field. The organization is primarily interested in older varieties, but they are also looking at modern crosses. Steven stressed out that in breeding, it is not just the agronomic aspect, but rather the economics as well. What is the end user going to be doing? We can breed the best wheat varieties that have the most diversity,

that work in most situations, but if no one is going to buy it, we failed. He presented LIVEWHEAT, a project inspired by LIVESEED, and shared a link in the chat. LIVEWHEAT is looking at a similar set of parameters, with farmer participatory and researchers helping coordinate growers. Nearly all used plant material are modern varieties. Some elite varieties, although best for organic growers in mainland Europe, are not suitable for UK climate and soil. He elucidated the problem with feed grains in the UK. Feed manufacturers are buying imported barley and not supporting domestic growers, which forces them to stop the barley production. As the next epidemic interrupts, the supply chain, the manufacturers will suffer. There is a steady growth of regional grain networks and regional participative breeding programs, who are starting to work together. Lastly, he thanked all participants for their presentation and complimented the whole meeting as educational.

2.12. Conclusions and closure of the meeting

Vladimir Meglič (KIS) opened the floor for the general discussion. Ferdinando Branca commented in relation to Steven's presentation that much more attention should be given to involving farmers. There should be more participatory activity, many of these cultivars and crops are cultivated in conventional ways. These kinds of projects need to support the transition from conventional to organic. Heterogeneous materials are utilized locally by several growers. He emphasized the importance of supporting this transition period and phase.

Vladimir Meglič (KIS) asked Paul Bilsborrow (UNEW) for commentary on Steven's discussion / presentation.

Paul Bilsborrow commented that there are several upcoming events in the UK regarding organic production soon.

Presentation of new Project officer Tatjana Tallarico and Policy officer Gisela Quaglia

Vladimir Meglič (KIS) introduced new Project officer of the project, Tatiana Tallarico. She is going to be the main contact point during this project and will follow all participants throughout the project. Her main responsibility will be to support the Consortium. Tatiana mentioned the upcoming review meeting at the end of August.

Vladimir Meglič (KIS) also introduced Gisela Quaglia, a Policy officer who will be following the project from a policy perspective. Gisela is working in the research and innovation unit, in programming of research related to agriculture and will closely follow this project. Gisela will also attend the review of this project, to catch up with the results.

With this Vladimir concluded the meeting and thanked all for participation and the presentation of results. In his opinion the project is making a big step forward, with plenty of data, results, steady progress, and as Ferdinando mentioned before, the project is on the right track. He thanked all participants for their input to WP leaders for the first draft of the PR 2 report.

3. IP sub-committee 3rd annual meeting: minutes

Project coordinator Vladimir Meglič (KIS) kindly greeted all participants of the online 3rd IP sub-committee annual meeting.

Members attending: Vladimir Meglič, presiding with Paul Bilsborrow, Heinrich Grausgruber, Helena Valas and Josef Holzapfel as a new member replacing Maximilian Mayer. Also present is Antoaneta Kuhar as Project Manager.

Pavel Horčička was not attending.

In a short introduction, the new member, Mr. Josef Holzapfel explained that he is a temporary replacement filling in for their new colleague that will join the IP Sub-committee shortly.

H. Valas continued with the meeting agenda.

3.1. Overall progress report

H. Valas presented the main achievements in WP8 (intellectual property field) in Year 3 and the overall progress report. The main activities of the Year 3 were: drafting of the D8.2 Interim Plan for Use and Dissemination of the Foreground, negotiations and drafting of the two IPR sample agreements – Material Transfer Agreement and ECOBREED Trademark Licensing Agreement, monitoring of the publications and monitoring of the dissemination activities. The overall progress in the past year is checked in the plan from the 2nd IP virtual annual meeting in July 2020.

No.	Activity	Participants	Timeframe	Achieved
1	Drafting of the Material Transfer Agreement (MTA) and Trademark Licensing Agreement	Lead: IP sub-committee Support: project partners	November 2010 to January 2021	√ January 2021
2	Distribution of MTA and TM Licensing Agreement. First MTA signed.	Lead: KIS Support: project partners	January 2021	√ January 2021
1	Analysis of collected data on expected project results and IP protection and exploitation strategy	Lead: IP sub-committee Support: KIS	December 2020 to March 2021	√ March 2021
4	Preparation and drafting of D8.2 Interim Plan for Use and Dissemination of the Foreground	Lead: KIS Support: IP sub-committee	February to April 2021	√ First draft in April 2021 – still in revision
5	Monitoring of the publications	Lead: IP sub-committee	June 2020 to June 2021	√
6	Monitoring the dissemination activities	Lead: IP sub-committee	June 2020 to June 2021	√

Action: IP sub-committee has taken notice and checked the overall progress report.

3.2. Report on the D8.2 - Interim Plan for Use and Dissemination of the Foreground and Key Exploitable Results

H. Valas presented the proposed delivery document D8.2. The document contains ECOBREED general exploitation plan and key exploitable results together with individual plans for IP protection and exploitation of the project results. IP Sub-committee will check with all project partners if the planned key exploitable results have changed from the last reporting period.

When it comes to individual exploitation plans, 8 project partners will exploit project results through IPR protection with licensing or selling, 12 are exploiting results by marketing a product,

methodology or process. Almost all respondents, 17, will exploit results through further research and 14 are exploiting results through publications. 12 partners will seek IPR protection of project results. Data shows that 4 partners are certain to file for IPR protection but have no plans for exploitation yet, while 4 partners already have commercialisation strategy for project results. Almost all partners will disseminate and publish the project results.

A. Kuhar explained that progress reports on dissemination indicators and key exploitable results will be updated regularly and reported in the progress reports of the project.

H. Valas also presented the table 25: Preparatory Business Case Questioner that will be distributed by the end of summer this year and serves as data gathering tool for preparation of business cases.

Action: IP Sub-committee has taken notice of the deliverable D8.2.

IP Sub-committee decided to proofread the document D8.2 by June 23.

Members also decided that H. Valas will inform TTO officers, by 8th of July, on the planned key exploitable results and inquire if there are any amendments.

3.3. Individual plans for exploitation

H. Valas reported on the individual exploitation plans, attached to the agenda of the meeting. The individual exploitation plans are based on the data collected thorough the IPR Survey and prepared for each project partner. They reflect planned actions related to the end results of the project. The data is presented in individual tables with the following information:

- Partner
- Organization profile
- Focus area
- Relevance of ECOBREED for your organization
- Exploitable results
- Exploitation strategy
- IPR strategy

Distributed tables are missing data on focus areas of project partners. It is expected that gathered information can change with the project progressing and once the key exploitable results are finalized. Sub-committee members were discussing if there is added value in defining focus area since most information about project partners is already included in other documents. It was also discussed that individual exploitation plans should be sent to project partners for further updates. It is also clear that some results will be in joint ownership, since there are more partners planning to protect and exploit project results than there are overall ECOBREED key exploitable results.

Action: IP Sub-committee has taken notice of the attached document with project partners' individual exploitation plans.

Sub-committee members decided to delete the focus area information in the tables. H. Valas will clear this section in the tables.

Members also decided that H. Valas will inform TTO officers, by 8th of July on individual exploitation plans and check if there are any amendments.

3.4. Plan Year 4

H. Valas presented planned activities for Y4, partly discussed at the relevant points of this 3rd annual meeting. Year 4 (Y4) marks continuation of work on business cases and beginning of negotiations for Exploitation Agreement as basis for the final Plan for the Use and Dissemination of Project Results. There is an ongoing work of IP Sub-committee to monitor dissemination and publication. Additional effort is dedicated to negotiating further Material Transfer Agreements, that will most likely become relevant once partners start negotiation on the Exploitation Agreement. Following is the plan for Y4:

No.	Activity	Participants	Timeframe
1	Distribution of table with ECOBREED project key exploitable results – for progress report and amendments	Lead partner: KIS Support: IP sub-committee	End June-first week of July 2021
2	Distribution of individual exploitation plans to all partners – for progress report and amendments	All project partners Contact point: KIS	End June-first week of July 2021
3	Analysis and up-dating of the gathered relevant information (in points 1 and 2 above)	Lead: KIS	By the end of July
4	Distribution of the additional questioner dedicated to business planning (Preparatory Business Case Questioner)	Lead: KIS Support: All project partners	July to August 2021
5	Analysis of collected data from the Preparatory Business Case Questioner and preparation of the business cases for key exploitable results (new seed varieties)	Lead: IP Subcommittee Support: all project partners	September 2021 to December 2021
6	Negotiations and preparation of the first draft of the Exploitation Agreements.	Lead: IP Subcommittee Support: KIS	January to March 2022
7	Negotiations and drafting of the Material Transfer Agreements to support the Exploitation Agreements	Lead: IP Subcommittee Support: all project partners	February to April 2022
8	Monitoring of the dissemination and publication activities	Lead: IP Subcommittee	Ongoing
9	Deliver 4th Exploitation Report for the period from May 1, 2021, till April 30 2022	Lead: IP Subcommittee Support: KIS	July 2022
10	Negotiations with project partners on licensing the Ecobreed TM	Lead: IP Subcommittee Support: KIS	Second half of 2022

Action: IP sub-committee has approved the proposed plan of activities for Y4.

3.5. Reporting to IP sub-committee – scientific publications + data

V. Meglič presented activities of IP Sub-committee regarding monitoring of the past and forthcoming publications and dissemination. Project partners are following the agreed protocol on informing prior to publication although sometimes the deadlines are too short.

In the past year and the months covering PR2 project partners published 23 scientific publications,

Action: Members agreed to continue monitoring all forthcoming publications and dissemination activities.

3.6. Miscellaneous

V. Meglič presented the additional on-line questioner about further exploitation and commercialization of project results. It is a new obligation on the part of the consortium. It is reported to the European Commission and will be done periodically. Members must decide if the testing activities of project partners' seed varieties fall under the category to be reported.

Action: Members decided that the testing activates constitute reportable results under the new questioned. V. Meglič will send the information about the questioner to WP leaders with short reporting deadline.

4. MS31: 3rd IP exploitation report

In the Year 3 ECOBREED and the IP sub-committee focused on the following areas:

4.1. Negotiating and drafting two template IPR agreements

Period from November 2020 till January 2021 was dedicated to drafting of the two sample agreements to be used by all project partners. The agreements were drafted by the IP subcommittee and revised by project TTO officers. Template agreements serve as a common standard of dealing with the project foreground and ECOBREED registered trademark.

MATERIAL TRANSFER AGREEMENT serves as a legal frame for project partners exchanging genetic material for the purposes of conducting the project tasks and delivering the agreed results. Signed agreements will help determine the contribution of each project partner to the end results and serve as negotiating points for final Exploitation Agreements.

TRADEMARK LICENSING AGREEMENT is template agreement for the use of the ECOBREED registered trademark. Project partners plan to use the registered TM for labelling purposes of new seed varieties in organic and ecological farming. The use of trademark is royalty free with focus on promoting the results of the ECOBREED project and strengthening the market position of newly developed varieties under common trademark ECOBREED improving crops TM.

In the reporting period for Year 3, there is one signed IPR agreement. The table will be periodically updated. It is expected that this activity will get momentum once the project partners start negotiating terms and conditions of the upcoming Exploitation Agreement.

Title	Parties	Date
Material Transfer Agreement	KIS and IFVC	February 2021

4.2. Preparation of deliverable D 8.2 and table of key exploitable results

In Year 3 the ECOBREED consortium members participated in the preparation of the ECOBREED general exploitation plan and key exploitable results for the whole consortium. Project partners also developed individual plans for IP protection and exploitation of the project results. IP Sub-committee will regularly check with all project partners if the planned key exploitable results have changed in each reporting period.

Key exploitable results of the consortium focus on results and deliverables of the ECOBREED project and are described in the deliverable D 8.2. The table of results is monitored by the IP Sub-committee and is also part of the project's periodic reports.

4.3. Preparation of individual plans of exploitation

Individual plans of exploitation are part of the activities dedicated to IPR protection, exploitation, and commercialization of the project results. Each project partner has already reported about plans for IPR protection in the IPR Survey (**MS29**). In the reporting period for Year 3, each project partner prepared individual exploitation plan and reported it in the table format as seen bellow.

- Partner
- Organization profile
- Relevance of ECOBREED for your organization
- Exploitable results
- Exploitation strategy
- IPR strategy

Tables with input data are part of the deliverable 8.2.

When it comes to individual exploitation plans, 8 project partners will exploit project results through IPR protection with licensing or selling, 12 are exploiting results by marketing a product, methodology or process. Almost all respondents, 17, will exploit results through further research and 14 are exploiting results through publications. 12 partners will seek IPR protection of project results. Data shows that 4 partners are certain to file for IPR protection but have no plans for exploitation yet, while 4 partners already have commercialisation strategy for project results. Almost all partners will disseminate and publish the project results.

Based on the data collected through initial IPR survey and individual exploitation plans, project partners declared to protect and exploit following categories of intellectual property rights: Plant Variety Protection (PVP), Patents and Trademarks.

Project activities in Year 3 are not at the stage that would result in filled PVP or patent applications, but project partners are starting to prepare business cases that will include exploitation and IPR protection plans.

4.4. ECOBREED exploitation activities

There were no significant exploitation activities in Year 3. ECOBREED project has so far developed results that fall in two intellectual property categories:

- *copyright:*

scientific and general publications, developed database, webpage.

- industrial property rights:

registered trademark “Ecobreed IMPORVING CROPS” (hereinafter TM). In the Year 3 the TM is used for project dissemination and communication. The trademark is not commercially exploited yet although consortium has a template Licensing Agreement that will establish ECOBREED TM as a general trademark to use in commerce with all newly developed seed varieties. In the Year 3 IP subcommittee started the debate quality control for the use of the registered TM and whether the use of the TM can be open to third parties, namely other producers of organic seed that are not project partners. These questions have not been answered yet.

4.5. Monitoring of the dissemination and publication activities

In the Year 3 the IP sub-committee was monitoring and evaluating all scientific publications and other forms of dissemination. All dissemination materials must be approved by the IP sub-committee prior to publication. All results/technologies with commercial potential or intellectual property issues are reported (a) to the project coordinator and (b) to the IP sub-committee. The list of all publications of the Year 3 is enclosed further.

4.6. Publications

All publications have been evaluated by the IP sub-committee. Altogether 23 publications have been published in the period covering PR2, of which: 7 articles in the peer-reviewed journals, 14 publications out of the conference proceedings/workshop, 1 thesis and 1 other publications. Details are presented in the table 1 below.

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Table 1. List of publications.

No.	Type	Title	Authors	Title of the Journal/Proc. /Book	Number, date or freq. of the Journal/Proc. /Book	Is Peer-reviewed?	Is Open Access?	DOI	Repository Link
1	Article in Journal	Comparison among Methods and Statistical Software Packages to Analyze Germplasm Genetic Diversity by Means of Codominant Markers	Mario Pagnotta	J	1/1	Yes	Green	10.3390/j1010018	https://zenodo.org/record/3941698#.X-Mhy9hKiUk
2	Article in Journal	Prediction of Soybean Plant Density Using a Machine Learning Model and Vegetation Indices Extracted from RGB Images Taken with a UAV	Predrag Ranđelović, Vuk Đorđević, Stanko Milić, Svetlana Balešević-Tubić, Kristina Petrović, Jegor Miladinović, Vojin Đukić	Agronomy	10/8	Yes	Gold	10.3390/agronomy10081108	https://zenodo.org/record/3978167
3	Article in Journal	Chlorophyll Fluorescence Kinetics May Be Useful to Identify Early Drought and Irrigation Effects on Photosynthetic Apparatus in Field-Grown Wheat	Lenka Botyanszka, Marek Zivcak, Erik Chovancek, Oksana Sytar, Viliam Barek, Pavol Hauptvogel, Andrej Halabuk, Marian Brestic	Agronomy	10/9	Yes	Gold	10.3390/agronomy10091275	https://zenodo.org/record/4059152#.X8_vhNhKiUk

4	Article in Journal	Bioaugmentation of Entomopathogenic Fungi for Sustainable Agriotes Larvae (Wireworms) Management in Maize	Jaka Razinger, Eva Praprotnik, Hans-Josef Schroers	Frontiers in Plant Science	11	Yes	Gold	10.3389/fpls.2020.535005	https://zenodo.org/record/4265994#.X8_updhKiUk
5	Article in Journal	Fagopyrum esculentum ssp. ancestrale-A Hybrid Species Between Diploid F. cymosum and F. esculentum	Cheng Cheng, Yu Fan, Yu Tang, Kaixuan Zhang, Dinesh C. Joshi, Rintu Jha, Dagmar Janovská, Vladimir Meglič, Mingli Yan, Meiliang Zhou	Frontiers in Plant Science	11	Yes	Gold	10.3389/fpls.2020.01073	https://zenodo.org/record/4315238
6	Article in Journal	Resequencing of global Tartary buckwheat accessions reveals multiple domestication events and key loci associated with agronomic traits	Kaixuan Zhang, Ming He, Yu Fan, Hui Zhao, Bin Gao, Keli Yang, Faliang Li, Yu Tang, Qiang Gao, Tao Lin, Muriel Quinet, Dagmar Janovská, Vladimir Meglič, Jacek Kwiatkowski, Olga Romanova, Nikhil Chrungoo, Tatsuro	Genome Biology	22/1	Yes	Gold	10.1186/s13059-020-02217-7	https://doaj.org/article/cf2d1e0a2b9444c79a4c57faf3a234f0

			Suzuki, Zlata Luthar, Mateja Germ, Sun-Hee Woo, Milen I. Georgiev, Meiliang Zhou						
7	Article in Journal	Breeding Buckwheat for Nutritional Quality in the Czech Republic	Dagmar Janovská, Michal Jágr, Pavel Svoboda, Václav Dvořáček, Vladimir Meglič, Petra Hlásná Čepková	Plants	10/7	Yes	Gold	10.3390/plants10071262	https://zenodo.org/record/5016834
8	Publication in Conference proceedings/Workshop	ECOBREED – Increasing the Efficiency and COmpetitiveness of organic crop BREEDing. A new H2020 project on organic breeding of wheat, potato, soybean and buckwheat	Grausgruber H., Meglič V., Hauptvogel P., Dolničar P., Petrović K., Janovská D., Bilsborrow P., Vogt-Kaute W., Pagnotta M., Kuhar A.G.	69. Tagung 2018 der Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs	Annual	No	Green	10.5281/zenodo.4315169	https://doi.org/10.5281/zenodo.4315169
9	Publication in Conference proceedings/Workshop	Soybean breeding for organic farming: breeding goals and options	Vollmann J., Bernhart M., Petrović K., Miladinović J., Djordjević V.	69. Tagung 2018 der Vereinigung der Pflanzenzüchter und Saatgutkaufleute	Annual	No	Green	10.5281/zenodo.4315172	https://doi.org/10.5281/zenodo.4315172

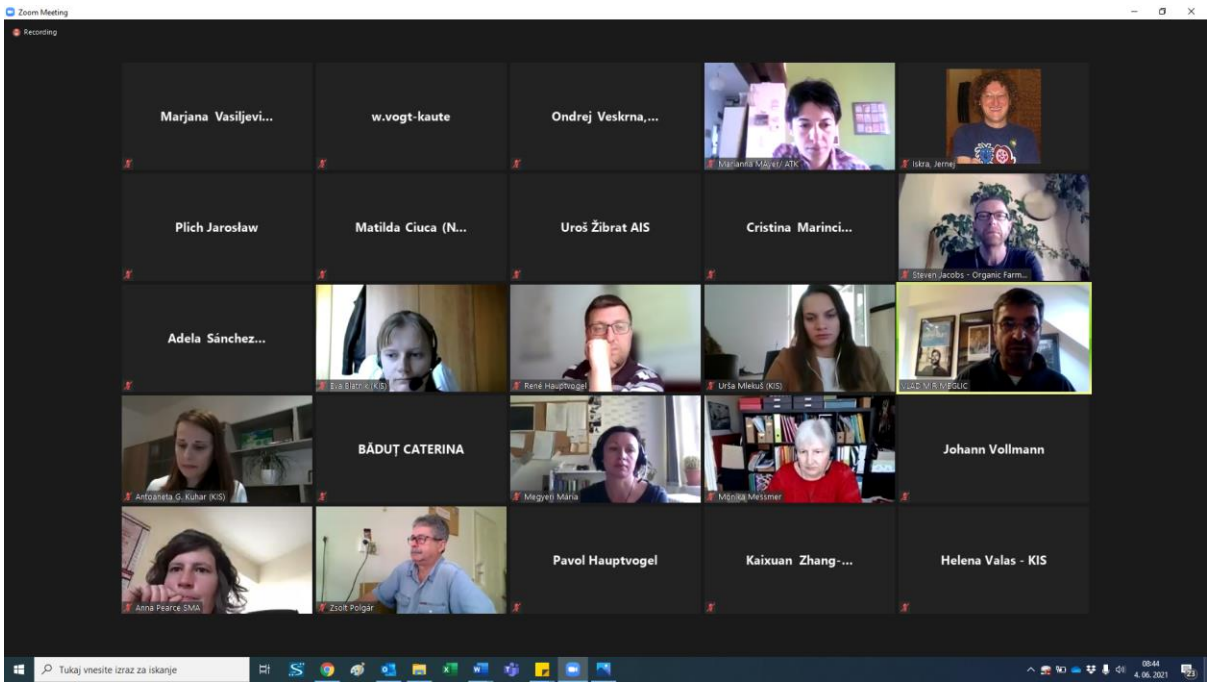
				Österreichs					
10	Publication in Conference proceedings/Workshop	ECOBREED: Increasing the Efficiency and Competitiveness of Organic Crop Breeding	Vladimir Meglič; Paul Bilsborrow; Dagmar Janovska; Heinrich GRAUSGRUBER; Peter Dolnicar; Mario Pagnotta; Kristina Petrovic; Antoaneta G. Kuhar; Werner Vogt-Kaute; Pavol Hauptvogel		1	No	Gold	10.5281/zenodo.4315252	https://zenodo.org/record/4315252
11	Publication in Conference proceedings/Workshop	PRELIMINARY SCREENING OF DURUM WHEAT BREEDING LINES UNDER ORGANIC CONDITIONS	FORTE P.; VITTORI D.; GRAUSGRUBER H.; VIDA G; PAGNOTTA M.A.	Proceedings of the LXIII SIGA Annual Congress	1	No	Gold	10.5281/zenodo.4463305	https://zenodo.org/record/4463305
12	Publication in Conference proceedings/Workshop	Zwiększenie wydajności i konkurencyjności ekologicznej hodowli roślin.	Beata, Tatarowska; Jarosław, Plich	STRESZCZENIA „Nowe strategie ochrony roślin”	1	No	Gold	10.5281/zenodo.4561503	https://zenodo.org/record/4561503
13	Publication in Confere	Partial results of the project 'Increasing the efficiency	Marinciu Cristina-Mihaela		1	No	Gold	10.5281/zenodo.4900629	https://zenodo.org/record/4900629

	nce proceedings/Workshop	and competitiveness of organic crop breeding'							
14	Publication in Conference proceedings/Workshop	Program ekološkega žlahtnjenja sort krompirja na Kmetijskem inštitutu Slovenije v okviru projekta ECOBREED	Peter Dolničar; Eva Blatnik; Vladimir Meglič		1	No	Gold	10.5281/zenodo.5035104	https://zenodo.org/record/5035104
15	Publication in Conference proceedings/Workshop	Efficacy of selected bioinsecticides against Colorado potato beetle	Primož Žigon; Marko Petek; Kristina Gruden; Eva Praprotnik; Špela Modic; Uroš Žibrat; Matej Knapič; Peter Dolničar; Jaka Razinger	NEW CHALLENGES IN AGRONOMY 2021		No	Gold	10.5281/zenodo.4315120	https://www.agronomsko-drustvo.si/wp-content/uploads/2021/02/NIA-2021-zbornik-simpozija.pdf
16	Publication in Conference proceedings/Workshop	Hyperspectral reflectance as a new phenotyping tool for soybean breeding	Vollmann, Johann; Rischbeck, Pablo; Pachner, Martin; Yao, Xindong; Rittler, Leopold; Qiu, Lijuan; Manschadi, Ahmad	The Frontiers of Science and Technology in Crop Breeding and Production Conference		No	Gold	10.5281/zenodo.4924076	https://zenodo.org/record/4924077#.YNjRl-gzY2w
17	Publication in	Proceedings of International Conference on	EUCARPIA Section	Abstract E-book and E-		No	Gold	10.5281/zenodo.4727960	

	Conference proceedings/Workshop	BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS.	Organic and Low Input Agriculture jointly with LIVESEED, BRESOV, ECOBREED, FLPP projects and ECO-PB	poster collection.					
18	Publication in Conference proceedings/Workshop	Anbauwürdigkeit von ausdauerndem Weizen in Deutschland	Vogt, Lukas	Boden gut machen – neue Ackerbausysteme		No	Gold	10.5281/zenodo.4680089	
19	Publication in Conference proceedings/Workshop	Perennial cereals for organic agriculture	Vogt-Kaute, Werner; Vogt, Lukas; Emmerling, Christoph; Titan, Primoz; Grausgruber, Heinrich			No	Gold	10.5281/zenodo.4675604	
20	Publication in Conference proceedings/Workshop	Estimation of soybean seed protein accumulation by measuring canopy hyperspectral reflectance	Vollmann, Johann; Pachner, Martin; Koppensteiner, Lukas; Rischbeck, Pablo; Manschadi, Ahmad	Tagungsband der 71. Jahrestagung der Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs		No	Gold	10.5281/zenodo.4675579	
21	Publicati	Selection of durum wheat	Pagnotta,	Tagungsband		No	Gold	10.5281/zeno	

	on in Conference proceedings/Workshop	lines under organic management - Preliminary results	Mario A.; Bonfiglioli, Luca; Forte, Paola	der 71. Jahrestagung der Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs				do.4675513	
22	Other	Projekt ECOBREED	Pavol Hauptvogel, Alžbeta Žofajová, Michaela Havrlentová, D. Janovíček	Genofond: informačný spravodajca	2	No	Gold	10.5281/zenodo.4315103	https://doi.org/10.5281/zenodo.4315103
23	Thesis/Dissertation	Markergestützte Selektion auf Steinbrand-Resistenz in Weizen	Nadine Worel		3	No	Gold	10.5281/zenodo.4315233	https://zenodo.org/record/4315233

Appendix 1: Photos



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