

*Breeding materials from the LIVESEED Project's subtasks concerning intra- and interspecific diversity and mixtures for agroforestry (extracted from Deliverable 3.6)*

## Improved plant populations (CCPs and DOPs)

The populations improved in the scope of LIVESEED with enhanced intraspecific diversity that can be commercialized as organic heterogeneous material (OHM) from 2022 onwards. The exploitation plans to bring these populations to the market have been developed by the different partners involved.

*Breeding materials developed within the trials targeting intra-specific diversity:*

Partner	Planned cultivar release	Planned year of release	Further use of the material
UBIOS & INRAE (France)	Three composite cross populations (CCP) were created to increase genetic diversity and to promote adaptation in different cultivation environments.	From 2022 Possible notification as OHM.	The CCPs will continue to be selected on farm.  Adoption by farmers on their farms (farms cultivars).  Multiplication and marketing under OHM to other farmers of the cooperatives, and maybe outside the cooperatives.
INRAE & ITAB (France)	Multiplication and distribution of Diversified Oriented Populations (rivet wheat, spelt, oat).  Diversified Oriented Populations (DOP) are composed of accessions (around 200) multiplied from gene banks, mixed according to farmers' criteria. Those populations are adapted to farmers' needs and created on their demand.	From 2022  Identify interesting populations that may be notified as OHM.	Distribution of DOPs and follow-up with involved farmers.  Use the same methodology to mobilize diversity of other species from gene banks, chosen out of farmers' needs.
AREI (Latvia)	Several spring barley composite cross populations (CCPs) were developed and tested in various environments at AREI within LIVESEED and national projects.	Already released  One of CCPS was already listed in the temporary experiment on Heterogenous Cereal Populations marketing.  From 2022  Additionally, one or two CCPs are foreseen to be notified as OHM in 2022. Another population, with AREI reference CCP-4, was tested by a seed producing farmer in 2020	The materials tested in LIVESEED trials are being re-used in further development of new CCPs and improvement of existing CCPs (mass selection, crosses done to and between CCPs) and selection of pure lines out of CCPs.

		and the farmer is interested to continue multiplication and marketing of this population starting from 2022.	
IPC (Portugal)	Widening maize genetic base for evolutionary breeding in Portugal. Populations selection from a broad source of genetic resources. Continuation of breeding of maize populations not yet registered. Newly developed composite cross population.	From 2022  Notification as OHM of the best performing populations	Continue to select CCPs from the material developed during LIVESEED.  Use recurrent selection to improve populations and extract some inbred lines. Further evaluation and selection of maize germplasm for human consumption.
FiBL CH	New CCP is being set-up at FiBL in 2021 from tolerant lines adapted for spring sowing and carrying the same mutation for low-alkaloid content.	From ca. 2028  Potential for notification as OHM after some years of selection and adaptation.	This new CCP will be monitored for yield, anthracnose tolerance and alkaloid content in the following growing seasons starting from 2022.

## Selections for interspecific mixtures and mixtures in mature agroforestry systems under organic farming conditions

The populations and cultivars selected for interspecific mixtures in the scope of LIVESEED which are available for the official variety registration or as candidate for the temporary experiment on organic varieties suited for organic production with adjusted DUS and VCU testing. The exploitation plans to bring these cultivars to the market have been developed by the different partners involved.

### *Breeding materials developed within the trials targeting inter-specific diversity:*

Partner	Planned cultivar release	Planned year of release	Further use of the material
GZPK (Switzerland)	Spring pea lines selected for mixed cropping with barley.  During LIVESEED activities barley was selected as best cereal partner for the selection of spring pea lines adapted to intercropping in Switzerland.  By screening a wide base of pea germplasm, promising varieties/traits were included in GZPK pea breeding program in mixed cropping with barley.	From 2030  The first crosses within the LIVESEED project were made three years ago. Thus, results from these crosses will be seen in varieties released in 10 or more years.	Continuous update of the germplasm material tested (supported by LIVESEED) to include new materials with positive traits as parental lines in the pea crossings for selection in mixed cropping.
CULTIVARI (Germany)	Winter-pea lines suitable for mixed cropping with winter triticale.	From 2021 application for VCU trials and registration.	Three of the tested breeding lines will be used as parents in further breeding to develop winter peas with better winter

		From 2035 Possible release of first cultivars.	hardiness and times of ripening suitable for mixed cropping with winter triticale. Additionally, CULTIVARI will test in a new project by different winter triticale varieties and breeding lines for their use as partner for winter peas.
LBI (Netherlands)	White lupin lines for mixed cropping.  Sweet lupin candle types, suitable for mixed cropping and suitable for calcareous soils under Dutch short season conditions.	From 2025  application of first candidates for official registration trials.	The material is released by LBI to a small breeding company; they aim to develop one or more lupin varieties that are suitable for mixed cropping with maize. The mixed lupin / maize crop is used as whole crop silage for ruminant animal feed.
AGROSCOPE (Switzerland)	During LIVESEED, two experimental populations of alfalfa based on parents that were selected for a good performance in a spaced plant nursery in combination with grasses were developed.  This genetic material of alfalfa is adapted to Swiss forage mixtures (local climate, frequent cutting, mixed cropping with drought tolerant grasses).	From 2034  application of first candidates for official registration trials.	The alfalfa material will be used to continue breeding activities to select alfalfa adapted for use in mixture with grasses.
NARDI (Romania)	Development of one dynamic wheat population, one wheat CCP and one barley CCP.	From 2022  Notification of the populations as Organic heterogeneous material (OHM).	All materials from LIVESEED will be used for further breeding.
IPC (Portugal)	Maize CCP developed in Agroforestry.	2030 application of first candidates for official registration trials.  Two years were accomplished in mass selection.	The maize CCP will be continued to be under selection and adapted to the agroforestry system. Plan the distribution for PPB for agroforestry from IPC.

*Breeding materials from the LIVESEED Project's subtasks concerning small breeding initiatives for lupin, Brassica species, apple, winter wheat and tomato (extracted from Deliverable 3.8)*

LUPIN

Partner	Planned cultivar release	Planned year of release	Further use of the material
CREA (Italy)	Inbred lines: few inbred lines have high drought tolerance, and two have good adaptation to calcareous soil (to be confirmed). All selected inbred lines have low alkaloid content	By 2023-24: identify one or two elite inbred lines to be proposed for variety registration	Further evaluation and selection (for lines already tested or never tested yet). Definition and validation of molecular marker-based breeding tools (e.g. genomic selection for specific traits)
CREA (Italy)	CCP: it has broad geographic base; inter-crossing between traditional landraces and improved cultivars; low alkaloid content selection.	2020: distribution of CCP to several organizations in Europe and Chile	Developing CCP adapted to pure stand and mixed stand in Northern Italy (CREA, by core budget), and other populations under development by other institutions. At least for Italy, a registration as OHM of few populations (in collaboration between CREA and Rete Semi Rurali) is envisaged after a period of further assessment of their agronomic value
LBI (NL)	Inbred lines: sweet lupin candle types, suitable for mixed cropping and suitable for calcareous soils under Dutch short season conditions. The activities of LBI on plant breeding are limited to the pre-commercial stages. For the introduction of the lupin lines as new cultivars, LBI cooperates with the breeder company Nordic Maize Breeding. This small breeder organization will use lines to develop options for mixed cropping with maize. The mixed lupin / maize crop is used as whole crop silage for ruminant animal feed.	2021-2023: follow-up evaluation By 2025: at least 1 line ready for registration	Continue the field evaluation of the lines to develop one or more lupin varieties that are suitable for mixed cropping with maize
FiBL-CH	14 advanced breeding lines of spring-sown white lupin with good anthracnose resistance have been developed. Among the developed lines, 1 is very sweet and promising for food production use. These advanced breeding lines will be further developed together by GZPK (third linked party of FiBL-CH) and common submission for registration of first candidate is foreseen in 2-3 years.	By 2025: obtain 1-2 lines ready for formal registration By 2028-2030: start seed marketing of new varieties	Further use of the advanced breeding lines developed in the ongoing pre-breeding programme for the development of inbred lines and CCPs

BRASSICA

Partner	Planned cultivar release	Planned year of release	Further use of the material
Kultursaat (Germany)	Open pollinated, CMS-free breeding lines of pointed cabbage adapted to the conditions of organic farming. Selected	By 2024 – 2025: submission for registration of at least	In Task 3.4.2, Kultursaat cultivars and breeding lines of kohlrabi, broccoli, white cabbage, pointed cabbage, red cabbage,

	<p>for early and medium-early ripening and for organoleptic quality.</p> <p>Kultursaat is responsible for cultivar development and submits the cultivars for registration. Sales and distribution of seeds marketing is handled by distribution partners such as Bingenheimer Saatgut or Sativa Rheinau.</p>	<p>one cultivar. Parallel seed production.</p>	<p>cauliflower and savoy cabbage have been tested at different Central and Southern European locations in 2018, 2019 and/or 2020. The pointed cabbage breeding lines are the most advanced in the breeding program. Most of the <i>Brassica</i> breeding lines tested in LIVESEED at different locations in Europe will undergo further selection steps in the next years. The results of the LIVESEED trial helped to assess the status of the respective variety development, to characterize the breeding lines and to identify further development needs.</p>
LSSV (Portugal)	<p>Promising advanced breeding lines of <i>Brassica rapa</i>, <i>B. napus</i> and <i>B. Oleracea</i>.</p> <p>Traditional Portuguese cultivars of <i>Brassica</i> crops improved specifically for cultivation under organic farming conditions and with</p> <p>improved uniformity and improved production compared with the landraces.</p>	<p>By 2023: at least 1 cultivar ready for registration</p>	<p>Further on-farm testing of varieties for better improvement and selection of potential cultivars.</p> <p>LSSV sends seeds back to INIAV (Instituto Nacional de Investigação Agrária e Veterinária) in Portugal and the material will be used for further crossings for plant breeding.</p>
Sativa (Switzerland)	<p>Cell fusion-free, open-pollinated broccoli varieties, adapted to production both in Northern and Southern Europe and kohlrabi varieties, adapted to the whole harvest season in Southern Europe (November-May).</p> <p>The varieties will be certified by the association Bioverita. The entire breeding programme has been conducted under organic conditions.</p>	<p>2021-2024: further on-farm evaluation and shortlist of candidate cultivars</p> <p>By 2025: at least 1 broccoli variety submitted for registration</p> <p>By 2026: at least 1 kohlrabi variety submitted for registration (regular or as amateur variety depending on results of homogeneity test)</p>	<p>As for most long-term breeding programs, Sativa will put effort in maintaining and continuously improving different broccoli and kohlrabi populations. Further, Sativa is planning to build up a trial network across Europe in order to get substantial results on adaptiveness and performance of breeding lines at different locations.</p>

## APPLE

Partner	Planned cultivar release	Planned year of release	Further use of the material
POC (Poma Culta, Switzerland)	<p>Candidate varieties selected under on-field organic conditions, that show reduced susceptibility to key apple diseases.</p> <p>The robustness of the selected genotypes is not based on individual</p>	<p>2022: submit first varieties for registration</p> <p>2026 and 2027: test sales</p>	<p>From the rest of the POC (Poma Culta) breeding programme, about 20 interesting genotypes with special characteristics in terms of disease tolerance and/or fruit quality (firmness, storability) are available for further testing and use as breeding parents. Particularly interesting genotypes from the remaining breeding</p>

	<p>resistance genes but on selection for complex traits.</p> <p>Introduction of new varieties by involving all stakeholders in the value chain.</p>		<p>material will be used by POC (Poma Culta) for further crosses and made available also to other breeders.</p>
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## WINTER WHEAT

Partner	Planned cultivar release	Planned year of release	Further use of the material
AGROLOGICA (Denmark)	<p>AGROLOGICA's participation in LIVESEED was focused on bunt research, and bunt resistance will be an important trait incorporated in most wheat material developed from AGROLOGICA.</p>	<p>Farmers, millers, bakers and one plant breeder (AGROLOGICA) has made a membership organisation, Landsorten. Seed will be disseminated within Landsorten to members only without official variety release.</p>	<p>AGROLOGICA participates to Landsorten: a membership organisation together with farmers, millers and bakers. Landsorten will distribute seed of AGROLOGICA cultivars only for experimental trials to the members. Farmers satisfied with the on-farm experiment trials can then use farm-saved seed for further production.</p>
DOTTENFELDERHOF (Germany)	<p>New bunt resistant cultivars resulting from fully organic breeding program.</p> <p>Breeding varieties which combine a resistance to common bunt with a high baking quality and other important agronomic traits (grain yield, competitive-ness against weeds, other disease resistances)</p>	<p>The lines obtained from crosses with lines in the AGROLOGICA trial will be tested in common bunt trials at DOTTENFELDERHOF in generations F2 - F5. The first lines are therefore tested in 2021-24. Promising lines are further tested in yield trials (in generations F7 and above) and released as varieties not before 2029.</p>	<p>In addition, breeders are provided with specific knowledge about the type of the resistance (Bt genes)</p>

## TOMATO

Partner	Planned cultivar release	Planned year of release	Further use of the material
UPV (Spain)	<p>The first comprehensive and public list of dozens of Spanish heirloom cultivars and landraces identified for their good adaptation to organic farming under Mediterranean conditions.</p> <p>Also, characterization sheets for each cultivar will be available, including brief description of yield, fruit traits and quality (taste, flavour, composition)</p>	<p>2022: diffusion of the list of selected cultivars</p>	<p>There is a remarkable amount of small/medium organic farmers and organic consumers interested in the recovery of the morphology and "taste of the past" cultivars (i.e. ancient heirlooms). The COMAV-UPV seedbank, founded in the 80s will provide the seed service for the selected cultivars. UPV will continue the research on this material and further use the broad range of accessions conserved in COMAV-UPV seed-bank.</p>
RSR (Italy)	<p>Well-performing, open pollinated, Ox-Heart tomato cultivars for organic production adapted to</p>	<p>2021: Preparation for notification of OHM for 2022 seed multiplication</p>	<p>Monitor evolution of the population and keep selecting (positive and negative selection)</p>

	<p>different pedo-climatic conditions in Italy.</p> <p>The SOLIBAM Ox-Heart tomato has a 10-year history of organic breeding: parental material was evaluated under organic conditions. All selection and multiplication stages following the initial crosses were carried out in organic farms.</p> <p>Ox-Heart tomato are a high value tomato for the Italian fresh market.</p>	<p>2022 - onwards: SOLIBAM Ox-heart OHM seed marketing through Arcoiris' catalogue</p>	
CREA-OF (Italy)	<p>The tomato MAGIC population developed and evaluated is a powerful breeding material to create varieties adapted to different environmental condition and organic management techniques.</p> <p>The 10 families selected are under evaluation other than for important agronomic traits also for the uniformity and stability characteristics.</p>	<p>2021: evaluation of the families and RILs developed during the project</p> <p>2022: list of varieties, HMs and RILs adapted to organic management cultivation will be released. Seeds will be available for organic farmers.</p>	<p>The developed varieties adapted to organic production and low input crop management, represent a stable, long-lasting collection and an important genetic resource both for scientists and farmers communities</p>