



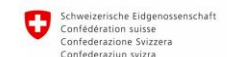
EVA

European Evaluation Network



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Innovative Organic fruit Breeding and uses InnOBreed (2022 - 2026)



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Stone & pome fruits

Progress and future actions

Baptiste Dumont & Daniela Giovannini



<https://innobreed.eu/>

This work has received funding from the Horizon Europe Framework Programme of the European Union under grant agreement No 101061028, InnOBreed project.



- 10** EU Countries
- 20** Partners
- 11** Research Institutes
- 2** Universities
- 4** NGO's
- 3** Privates associations



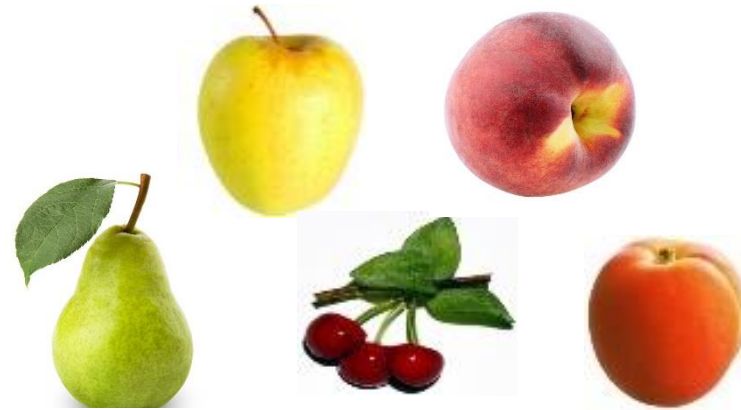
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InnOBreed

A project dedicated to **fruit perennial crops (pome & stone fruits, but also citrus and grape)**, focusing on **growers needs**



Aim: Foster the **organic fruit crop sector** by addressing the **challenges** of the stakeholders



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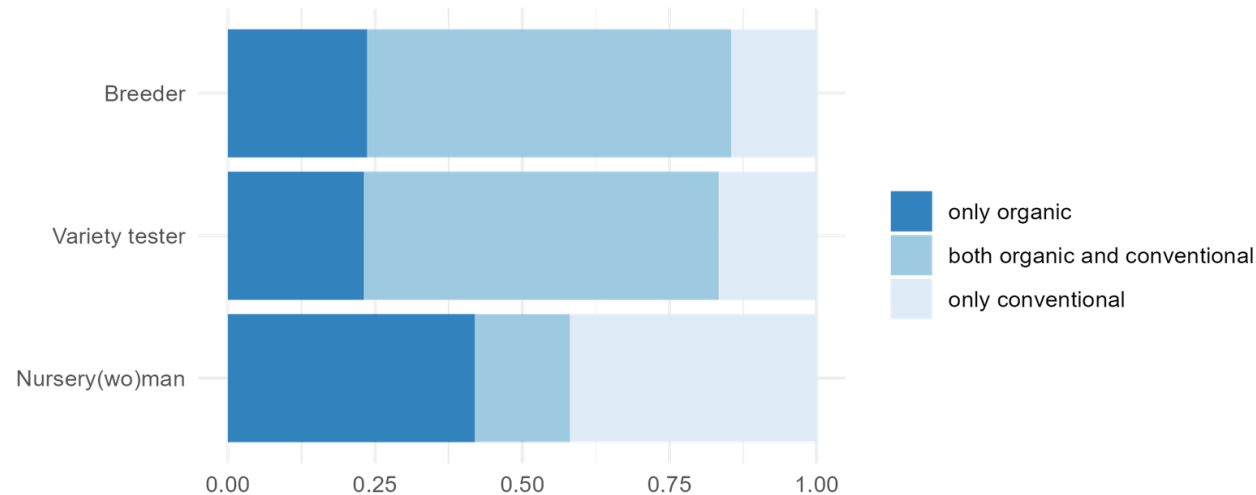
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The first step: Survey on stakeholders' needs

Goal : Assess the needs of the fruit production sector

- 126 Participants from 11 countries
 - 44 breeders,
 - 59 variety testers,
 - 23 nurserymen

✓ Most breeders and variety testers work on both conventional and organic



✓ There is an urgent need for cultivars adapted to organic and low input conditions

FiBL

INRAE

Wallonie
recherche
CRA-W

Agroscope

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In collaboration with
all InnOBreed Partners



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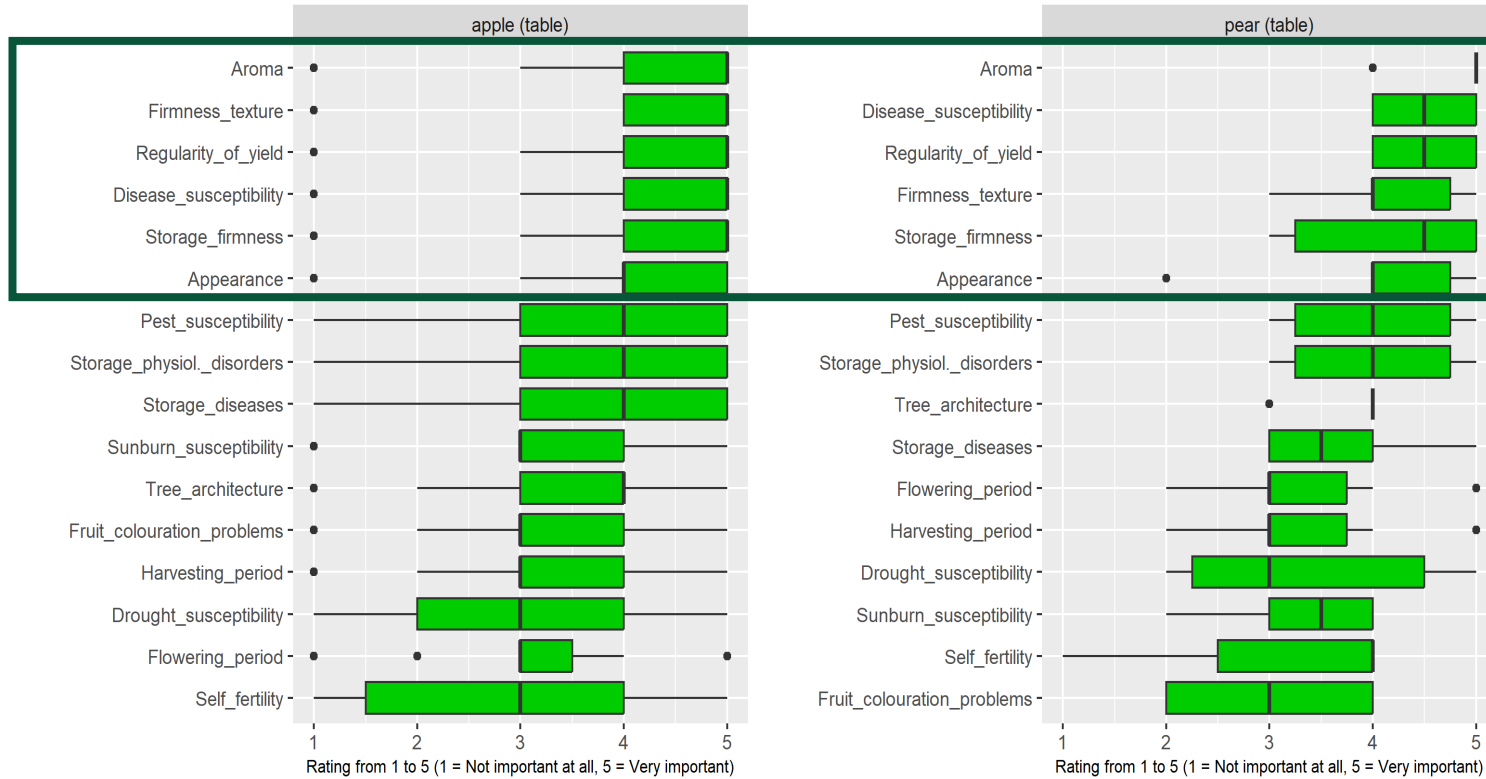
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Survey: Breeding & Evaluation criteria

relative importance of the traits for the end-users



- Appearance
- Aroma
- Firmness
- Storability



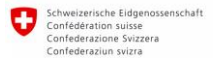
- Disease susceptibility
- Regularity of yield



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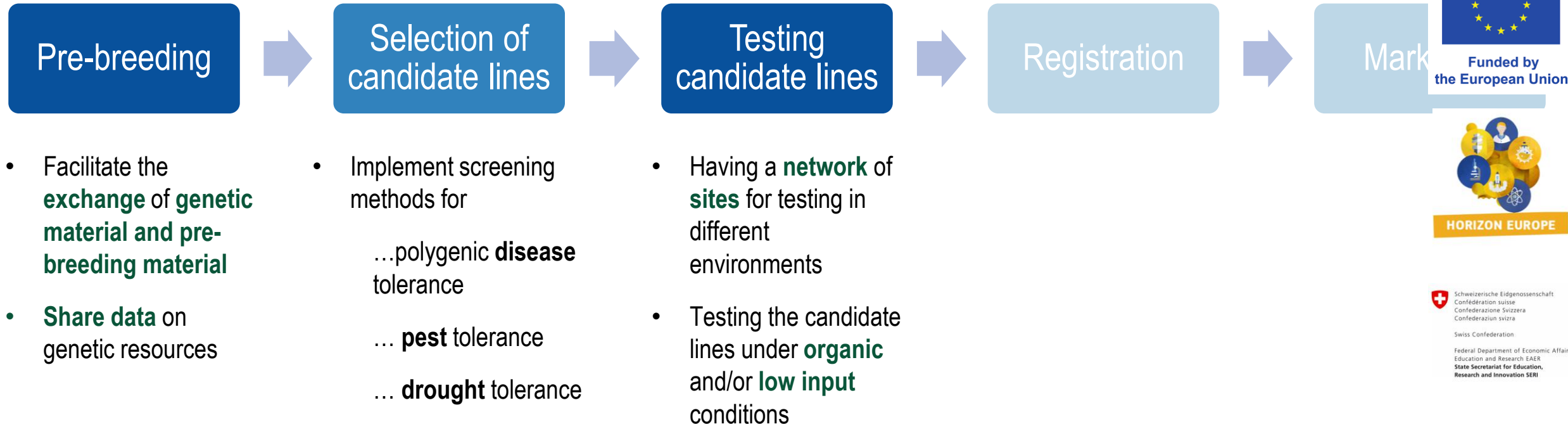


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Survey: Ranking needs by importance

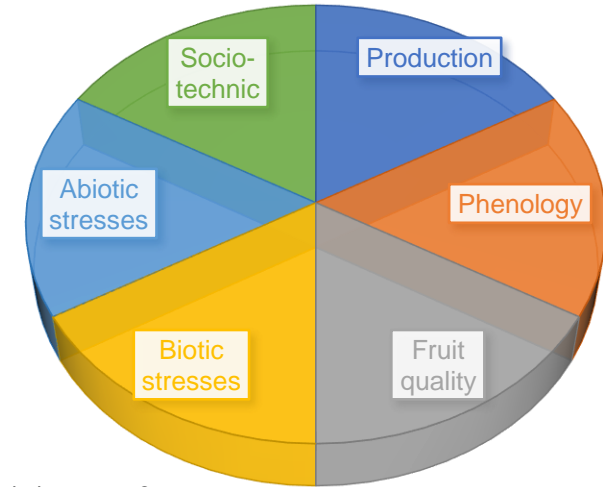


Global approach

Objectives [\(link to ECPGR\)](#)

- Interconnect the collections
 - Harmonize protocols and descriptors
 - Better evaluate the accessions
 - Facilitate the exchange of accessions
 - Share evaluation data
 - Select material for : (i) **robustness**: dynamic adaptability to biotic & abiotic stresses; (ii) good **diseases tolerance**; (iii) **yield & quality**
- Transfer the experience from model crops to others

TRAITS IMPLEMENTATION & CHARACTERIZATION



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Actions

- Developing **participatory approaches** for better utilization of local fruit genetic resources with "robustness" traits.
- Better **Inter-connect partners** acting in breeding and evaluation
- Implementing **harmonized protocols/descriptors** and commonly agreed-upon methods.

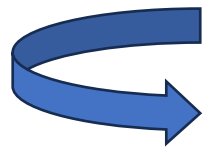
Activities organized in working groups (WG)



Working groups are participative and members agreed to share knowledge, expertise, and data

A WG for each crop :

- Selection of Priority Traits crop by crop
- Harmonization of the protocols/descriptors (mainly based on ECPGR/EUFRIN)
- Implementation and validation of the protocols



**Aiming also to contribute to ECPGR activities
with new relevant & prospective traits**

WGs on transversal topics : abiotic stresses, breeding networks, etc.

Pome fruit WG



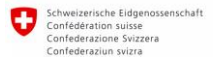
Team coordinators per crop :

- APPLE: Marc LATEUR (CRA-W) + Clémence BOUTRY (FiBL) + Baptiste DUMONT (CRA-W)
- PEAR: Marc LATEUR (CRA-W) and Danilo CHRISTEN (AGROSCOPE) + Baptiste DUMONT (CRA-W)

Partners of the pome fruit working group: FiBL, Poma Culta, IRTA, CREA-OFA, AGROSCOPE, CRA-W, SERIDA, ÖON, PLEN, CTIFL, BOKU, VSUO



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Selection of the priority traits for apple



Type of material:

- Genetic resources
- Breeding populations
- Breeding Elites Material in experimental fields
- Organic variety testing



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Phenology	Beginning blooming (BBCH 61)
	Full blooming (BCCH 65)
	End of blooming (BCCH 67)
	Relative flowering season
	Duration of the blooming period
	Flowering intensity
	Regularity of flowering
Biotic and abiotic stresses	Apple scab (<i>Venturia inaequalis</i>) on Leaves
	Apple scab (<i>Venturia inaequalis</i>) on Fruits
	Powdery mildew (<i>Podosphaera leucotricha</i>)
	European canker (<i>Neonectria ditissima</i>)
	Rosy Apple aphid – (<i>Dysaphis plantaginea</i>)
	Sunburn susceptibility/ on FRUITS

Robustness	Relative Tree Vigour
	Global tree & foliage health
Yield and quality	Fruit bearing habit
	Relative fruit harvest maturity
	Crop load (2 months after full flowering)
	Productivity/Yield (Kg/tree/year)
	Regularity of productivity
	Fruit size
	Average fruit weight
	Fruit crunchiness (sensory analysis)
	Fruit sugar content (measured)
	Fruit ratio acidity/sweetness (sensory analysis)
Fruit flesh overall fruit quality (sensory analysis)	

- Harmonization of the descriptors (common scales and descriptors among crops and partners)
- Explanation/improvement/exchange of experiences on the evaluation methods and descriptors during **monthly online meetings**

Main focus for apple

European canker



Apple scab



Global foliage health



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Selection of the priority traits for Pears



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Phenology	Beginning blooming (BBCH 61)
	Full blooming (BCCH 65)
	End of blooming (BCCH 67)
	Relative flowering season
	Duration of the blooming period
	Flowering intensity
	Regularity of flowering
Biotic and abiotic stresses	Pear scab - Venturia pirina/ Leaves
	Pear scab - Venturia pirina/ Fruits
	Pear scab - Venturia pirina/ on twigs & branches
	Sunburn susceptibility on fruits

Robustness	Relative Tree Vigour
	Global tree & foliage health
	Relative fruit harvest maturity
Yield and quality	Crop load / Annual production (2 months after full flowering)
	Fruit size
	Productivity/Yield (Relative assessment)
	Productivity/Yield (Kg/tree/year)
	Regularity of productivity
	Fruit firmness/Penetrometer
	Fruit sugar content/Refractometer
	Fruit ratio acidity/sweetness/Sensory analysis
	Fruit flesh overall fruit quality/Sensory analysis

- Harmonization of the descriptors (common scales and descriptors among crops and partners)
- Explanation/improvement/exchange of experiences on the evaluation methods and descriptors during **monthly online meetings**

Main focus for Pears

Pear scab



Global foliage health



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Pome and stone fruits : harmonization of the assessment scales for pests & diseases



- ✓ Same scale to assess all biotic stresses
- ✓ Exponential and not linear
- ✓ Same scale across crops

Ranking 1 to 9	% of symptoms
1	0
2	1-3
3	3-8
-	-
5	15-30
-	-
7	45-60
-	-
9	>75

Rating	1	2	3	4	5	6	7	8	9
Susceptibility	No	Very low	Low	x	Medium	x	High	x	Very high
% leaves attacked	0%	0-1%	1-5%		15-30%		45-60%		>75 %
Description	Absence of symptoms		immediately visible symptoms on few leaves		medium % of leaves with symptoms		high % of leaves with symptoms		very high % of leaves with symptoms

Eg: leaf curl scale in peach



Rating	1	2	3	4	5	6	7	8	9
Photo									



Stone fruit WGs Peach, apricot, cherry, plum

WGs coordinators:

David Tricon (INRAE)

Daniela Noll (BOKU)

Andreas Spornberger (BOKU)

Daniela Giovannini (CREA)

Clémence Boutry (FiBL)

Radek Vavra (VSUO)


Jean-Marc Audergon (INRAE)

Danilo Christen (WBF)



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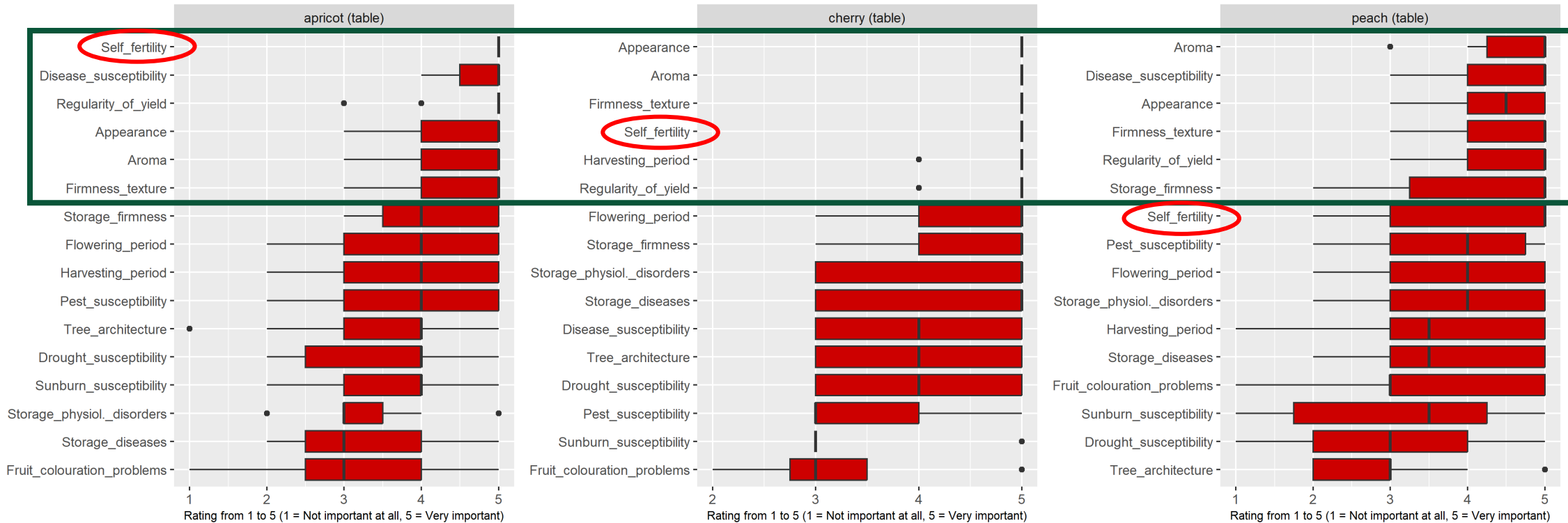


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Survey: Breeding & Evaluation criteria relative importance of the traits for the end-users



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- Appearance
- Aroma
- Firmness



- Disease susceptibility
- Regularity of yield
- Self-fertility

Peach working group:

Coordinators: Andreas Spornberger, Daniela Noll, Daniela Giovannini



Partners:

BOKU Vienna	INRAE Avignon	INRAE Bordeaux	CREA Rome	CREA Forli	CRSFA Bari	CTIFL Bellegarde	CEP Innovation
Austria	France	France	Italy	Italy	Italy	France	France
Andreas Spornberger, Daniela Noll	David Tricon JM Audergon	Marine Delmas	Sabrina Micali, Elisa Vendramin	Daniela Giovannini, Federica Brandi	Pasquale Venerito	Julien Ruesch, Florence Fevrier	Guillaume Roch
Evaluator	Research	Evaluator	Research	Research	Research	Evaluator	Private breeder
Case study					Case study	Case study	Case study



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Type of materials :

- Old and traditional cultivars
- Modern cultivars
- Genetic resources (core collections)
- Breeding selections

21 traits with priority 1

Traits related to:	#
Phenology	8
Tree Performance	3
Fruit quality	5
Biotic stresses	5

Peach working group:

Traits : 21 with priority 1



Traits related to :	Nb of traits with priority 1
Phenology	8 Beginning of Leaf bud burst Beginning of blooming Full blooming Flower intensity End of blooming Length of blooming period Fruit set Beginning of ripening
Tree performance	3 Tree vigor Yield/crop load Global tree and foliage health
Fruit quality	5 Fruit size/weight Sugar content Overall sensorial fruit quality Overall sensorial and esthethical fruit quality Flesh adherence to stone

Traits related to :	Nb of traits with priority 1
Biotic stresses	5 Leaf curl (Taphrina deformans) Brown rot on flowers/ twigs (Monilinia spp) Brown rot on fruits (Monilinia spp.) Powdery mildew (Podosphaera pannosa) Sharka

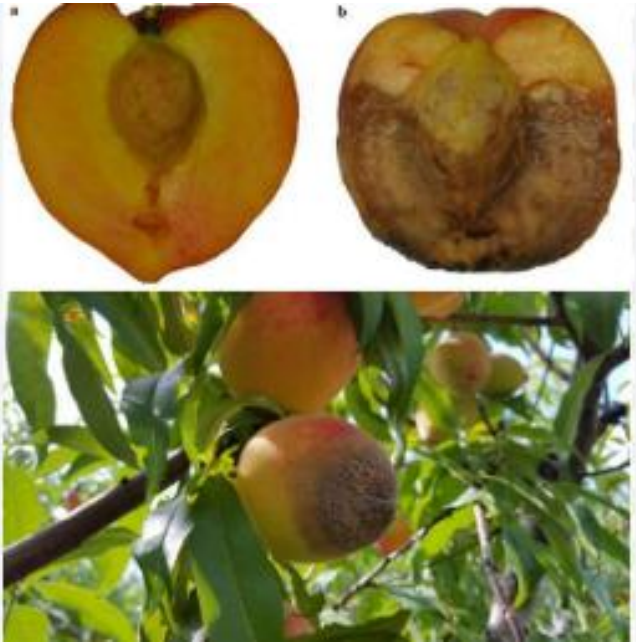


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Main biotic issues for Peach



Brown rot on mature fruits (*Monilinia*)



Leaf curl (*Taphrina deformans*)



Powdery mildew (*Sphaerotheca pannosa*)



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Apricot working group:

Coordinator: David Tricon, Jean-Marc Audergon, Danilo Christen



Partners involved:

BOKU Vienna	INRAE Avignon	INRAE Gothenon	WBF - Agroscope	CREA Rome	FiBL	CTIFL	GRAB	CEP Innovation
Austria	France	France	Switzerland	Italy	Italy	France	France	France
Andreas Spornberger, Daniela Noll	David Tricon, Jean-Marc Audergon	Laurent Brun, Mathilde Le Pans	Danilo Christen	Sabrina Micali, Elisa Vendramin	Michael Friedli, Clemence Boutry, Sara Amsler	Florence Fevrier	Claude-Eric Parveaud	Cédric Pierru, Guillaume Roch
Evaluator	Research	Research	Research	Research	Research / Evaluator	Evaluator	Evaluator	Private breeder
Case study					Case study	Case study	Case study	Case study



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Type of materials :

- Old and traditional cultivars
- Modern cultivars
- Genetic resources (core collection)
- Breeding selections

Traits : 28 with priority 1

Traits related to :	Nb of traits with priority 1
Phenology	8
Tree performance	3
Fruit quality	6
Abiotic stresses	2
Biotic stresses	9

Apricot working group:

28 traits with priority 1

Traits related to :	Nb of traits with priority 1
Phenology	8 Beginning of blooming Full blooming Flower intensity End of blooming Length of blooming period Self-fertility Fruit set Time of beginning of ripening
Tree performance	3 Tree vigor Global tree and foliage health Yield/crop load
Fruit quality	6 Fruit size/weight Sugar content Acidity content Fruit firmness Flesh texture Fruit taste



Traits related to :	Nb of traits with priority 1
Abiotic stresses	2 Floral necrosis Floral abnormalities
Biotic stresses	9 Brown rot blossom blight Bacterial canker on shoots and branches Bacterial canker on leaves and fruits Rust disease on leaves Shot hole disease on leaves Aphids damages (various species) European Stone Fruit Yellow (ESFY) Sharka disease Damages on fruits due to biotic stresses



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Main biotic issues for Apricot



Brown rot blossom blight (*Monilinia laxa*)



Bacterial canker (*Pseudomonas* sp.)



Rust disease (*Tranzschelia prunispinosae*)

Cherry working group:

Coordinators: Daniela Giovannini, Clemence Boutry

Partners involved:

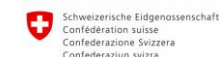
CREA Forli	VSUO, Holovousy	FiBL	BOKU Vienna	INRAE Bordeaux	CRSFA, Bari	CRA-W,
Italy	Czech Republic	Switzerland	Austria	France	Italy	Belgium
Daniela Giovannini Federica Brandi	Radek Vrava	Michael Friedli, Clemence Boutry	Andreas Spornberger, Daniela Noll	José Quero Garcia, Marine Delmas	Pasquale Venerito	Mark Lateur
Research/Evaluator	Research/Evaluator	Research/Evaluator	Evaluator	Research/Evaluator	Research/Evaluator	Research/Evaluator
	Case study	Case study	Case study		Case study	Case study



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Type of materials :

Old and traditional cultivars

Modern cultivars

Breeding selections

Traits: 14 with Priority 1

Traits related to:	Nb of traits with priority 1
Phenology	5
Yield / Fruit quality	4
Tree vigor	1
Abiotic stresses	1
Biotic stresses	3
Biotic stresses (not priority 1)	1 or 2

Cherry working group:

Traits :

12 to be assessed in InnOBreed

Traits related to :	Nb of traits with priority 1
Phenology of blooming and harvesting	6 Beginning of blooming Full blooming Flower intensity End of blooming Length of blooming period Beginning of harvest
Tree performance	2 Tree vigor Global tree and foliage health
Yield and fruit quality	2 Yield/crop load Fruit size



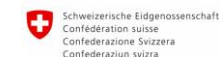
Traits related to :	Nb of traits with priority 1
Abiotic stresses	1 Fruit cracking
Biotic stresses	1 Blossom blight and fruit rot (Monilia) Bacterial canker (<i>Pseudomonas</i>) Cherry leaf spot (<i>Blumeriella</i>) Shot hole (<i>Corineum</i>)



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Main issues for Cherry



Fruit cracking



Brown rot blossom blight (*Monilinia* spp)



Brown rot on fruits (*Monilinia* spp.)

Bacterial canker



Cherry leaf spot



Shot hole



VSUO (CZ) and INRAE (F)



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Plum working group:

Coordinator: Radek Vavra (VSUO), Jean-Marc Audergon (INRAE)

Partners involved: VSUO, INRAE, CRA-W, FiBL, other partners joining

VSUO, Czech Republic	INRAE Bordeaux
Radek Vrava	José Quero Garcia, Marine Delmas
Czech republic	France
Research/Evaluator	Research/Evaluator
Case study	

Type of materials :

Traditional and local cultivars
Modern cultivars
Breeding selections



WG still under construction: will be in line with others WGs

Traits :

Restricted list of 10 traits with Priority 1 were selected and need to be approved



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In all the crop WGs

Priority 1 traits: Blooming and maturity dates, flower intensity/density


Partners are also providing meteo data at their orchard/collection site



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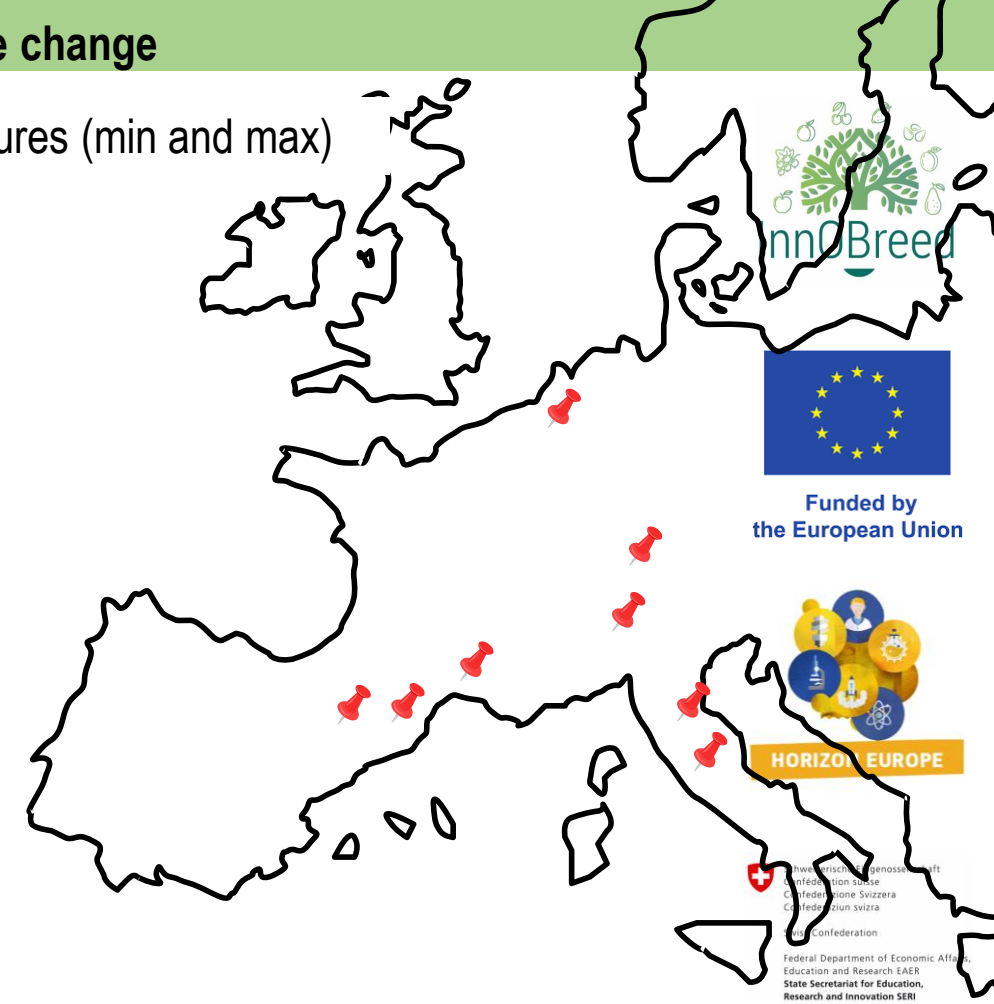
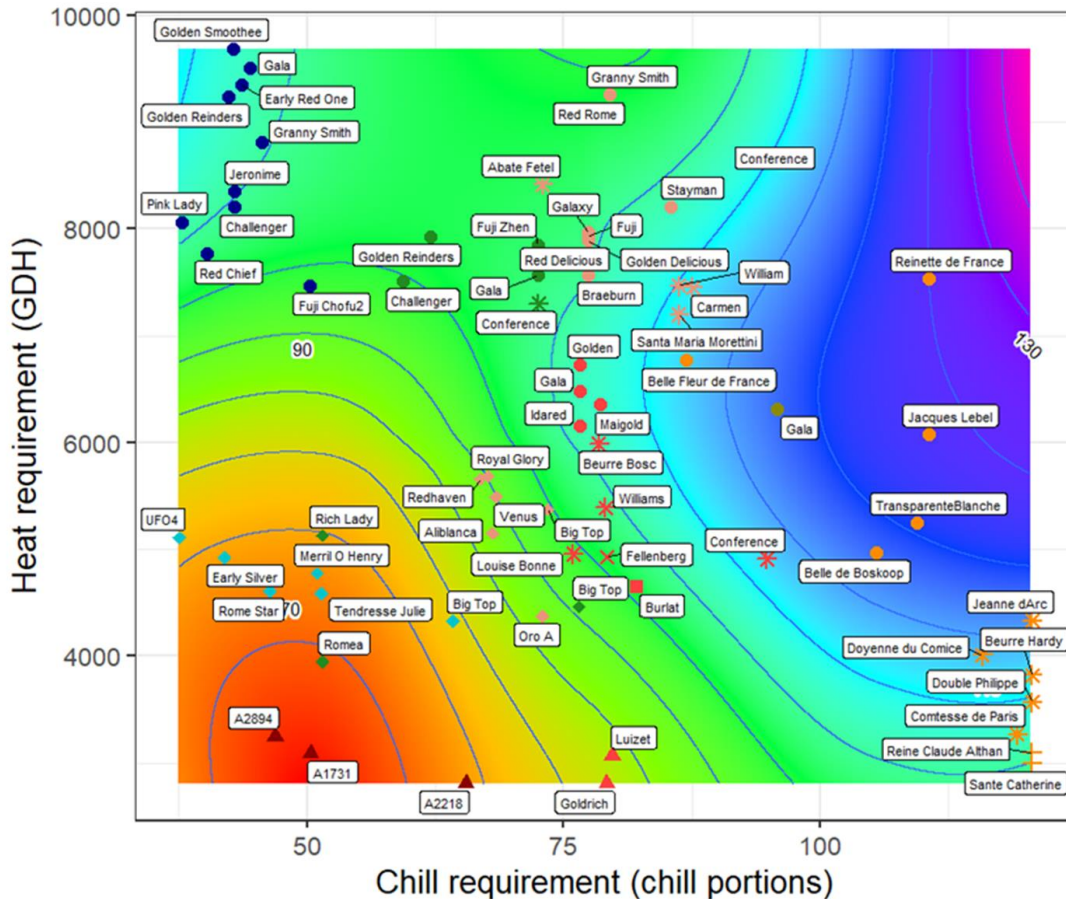
Development of models to predict flowering dates under climate change

Based on the historical series of blooming & harvesting dates and daily temperatures (min and max)

8 locations
7 crops
> 15 years series



Chill and heat requirements for flowering over Europe



Perspective: Increasing difficulty in satisfying cold requirement and consequent disorders in flowering and vegetative regrowth

PRACTICE ABSTRACTS to help assessing susceptibility and/or distinguish diseases



Pseudomonas vs. Cherry leaf spot vs. Shot hole disease

How to distinguish and assess Bacterial canker, Cherry leaf spot, and Shot hole disease

Problem: The cherry diseases Bacterial canker (*Pseudomonas* spp.), Cherry leaf spot (*Blumeriella jappa*) and Shot hole disease (*Stigmata arboricola*) are difficult to distinguish due to similar symptoms.

Solution: Bacterial and fungal diseases have distinct symptoms and infection periods. Understanding these differences enables accurate disease identification and management.

Details: Correct diagnosis improves disease control and helps identify tolerant cherry varieties.

Product recommendations:

Applicability box:

Theme: Crop production, Disease and pest control

Keywords: Plant protection, Plant disease control

Context: Cherry production areas, Temperate regions

Application time: Vegetative period

Shot hole disease:

SHOT HOLE DISEASE (*Stigmata arboricola*)

Theme: Crop production, Disease control

Keywords: Fungus

Context: Infestations in infected drupe, pits and in twig cankers. Spores viable for months in water 12 to 15 and viable leaf infection. Pits are spread fast in spring. Infests non-central fruit spring to autumn (throughout the vegetation period) and in cold winters. Cankers are produced and spread during leaf wetness. Fungal spores spread through leaf wetness and spread to healthy leaves through wounds or natural cracks (cracks, scratches, abrasions) before spreading from infected tissues.

Cherry leaf spot:

CHERRY LEAF SPOT (*Blumeriella jappa*)

Theme: Crop production, Disease control

Keywords: Fungus

Context: Infestations in infected drupe, pits and in twig cankers. Spores viable for months in water 12 to 15 and viable leaf infection. Pits are spread fast in spring. Infests non-central fruit spring to autumn (throughout the vegetation period) and in cold winters. Cankers are produced and spread during leaf wetness. Fungal spores spread through leaf wetness and spread to healthy leaves through wounds or natural cracks (cracks, scratches, abrasions) before spreading from infected tissues.

Bacterial canker:

BACTERIAL CANKER (*Pseudomonas* spp.)

Theme: Crop production, Disease and pest control

Keywords: Bacteria

Context: Infestations in infected drupe, pits and in twig cankers. Spores viable for months in water 12 to 15 and viable leaf infection. Pits are spread fast in spring. Infests non-central fruit spring to autumn (throughout the vegetation period) and in cold winters. Cankers are produced and spread during leaf wetness. Bacterial spores spread through leaf wetness and spread to healthy leaves through wounds or natural cracks (cracks, scratches, abrasions) before spreading from infected tissues.

Symptom pictures:

Important note: While visual clues can help in identifying potential diseases, only laboratory analysis can provide a definitive diagnosis.

Further information:

Further reading:

Web links:

Additional this practice abstract:

QR CODE

Cherry leaf spot

How to recognize and control Cherry leaf spot (*Blumeriella jappa*) in organic orchards

Problem (approx. 150 characters): Cherry leaf spot caused by the fungal pathogen *Blumeriella jappa* is a fungal disease causing premature defoliation. Leaf drop in an orchard reduces the fruit size and quality.

Solution (approx. 150 characters): Describe the practical approach to the solution in 1-2 paragraphs. Mention under what conditions the method was developed and tested.

Based on an earlier validated protocol, the authors developed a practical approach for organic cherry orchards. The authors tested the protocol in 2021 and 2022 in organic cherry orchards in Austria, Italy, and Germany. The authors evaluated the effectiveness of the protocol in terms of yield, fruit quality, and leaf retention.

Applicability box (max. 200 characters):

Theme: Crop production, Disease control

Keywords: control

Context: organic regions

Application time: active period

Further reading:

Web links:

Additional this practice abstract:

QR CODE

Leaf curl (peach)

How to assess the susceptibility of peach cultivars to Leaf Curl (*Taphrina deformans*)

Problem (approx. 150 characters): Leaf curl is the most important challenge in organic peach & nectarine cultivation. Infected trees have a reduced photosynthesis during spring, which might result in a lower yield.

Solution (approx. 150 characters): Describe the practical approach to the solution in 1-2 paragraphs. Mention under what conditions the method was developed and tested.

Based on an earlier validated protocol, the authors developed a practical approach for organic peach cultivation. The authors tested the protocol in 2021 and 2022 in organic peach orchards in Austria, Italy, and Germany. The authors evaluated the effectiveness of the protocol in terms of yield, fruit quality, and leaf retention.

Applicability box (max. 200 characters):

Theme: Crop production, pest and disease control, (See Applicability box for list of themes to choose from, maximum 5)

Keywords: plant disease control, disease tolerance (See Applicability box for list of keywords to choose from, maximum 5)

Context: Mediterranean, temperate and continental peach production areas (e.g. geographical coverage, climate, production, etc.)

Application time: Spring (April to May) (Indicate the time of year/year of application, month)

Required time: About 3 minutes per cultivar (Indicate the amount of time when the method/practice can be applied)

Period of impact: 1 year

Table 1. Rating scale of susceptibility to Leaf curl based on the amount (%) of leaves affected.

Rating	1	2	3	4	5	6	7	8	9
Susceptibility	No	Very low	Low	Medium	High	Very high			
% leaves affected	0%	0-5%	5-10%	10-20%	20-40%	40-60%	60-75%	75-90%	>90%

Table 2. Rating of other susceptible peach cultivars based on the % of symptomatic fruit observed during 1 field inspection.

Rating	1	2	3	4	5	6	7	8	9
Inspection	No symptoms	Very low	Low	Medium	High	Very high			
% fruit affected	0%	0-5%	5-10%	10-20%	20-40%	40-60%	60-75%	75-90%	>90%

Further information (approx. 150 characters):

Video: Check the following video (indicate title, put a hyperlink to the site and underline it) for further information (indicate language).

Further reading: (refer to existing technical guides, handbooks etc.)

Web links: Check the Organic Farm Knowledge platform for more practical recommendations (refer to other websites).

About this practice abstract:

QR CODE

Powdery mildew (peach)

Assessment of the susceptibility of peach cultivars to Powdery mildew (*Podosphaera pannosa*)

Problem (approx. 150 characters): Powdery mildew is a major disease in peach caused by the ascomycete *Podosphaera pannosa*. White spots on leaves, shoots, and fruit are the infection's earliest signs. Severe infections may reduce leaves to 100% prematurely, which affects the quality and quantity of peach production.

Solution (approx. 150 characters): Powdery mildew is also in organic peach orchards. It kept under control with sulphur-based preventive treatments beginning at petal fall. Choosing more tolerant peach varieties is a desirable alternative. The authors developed a practical approach to assess the assessment of peach varieties susceptibility to powdery mildew through field observations.

Applicability box (max. 200 characters):

Theme: Crop production, Disease and pest control

Keywords: plant protection, disease tolerance

Context: Mediterranean and temperate peach growing areas

Application time: Spring (April to May) (Indicate the time of year/year of application, month)

Required time: About 3 minutes per cultivar (Indicate the amount of time when the method/practice can be applied)

Period of impact: 1 year

Table 1. The susceptibility of peach cultivars to powdery mildew based on the % of symptomatic fruit observed during 1 field inspection.

Rating	1	2	3	4	5	6	7	8	9
Inspection	No symptoms	Very low	Low	Medium	High	Very high			
% fruit affected	0%	0-5%	5-10%	10-20%	20-40%	40-60%	60-75%	75-90%	>90%

Table 2. Rating of other susceptible peach cultivars based on the % of symptomatic fruit observed during 1 field inspection.

Rating	1	2	3	4	5	6	7	8	9
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About this practice abstract:

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Research and Innovation SERI

Some difficulties faced: References and other issues

Few common References across collections
 Different management systems and orchard design
 No replicates in germplasm collections



Data processing with non conventional statistical approaches is being studied



Name	VSUO Cvs	VSUO Gen.Res.	CREA	CRSFA	INRAe	FiBL	Boku	CRA-W	SUM of sites
Kordia	x	x	x		x	x	x	x	7
Burlat	x	x	x		x				4
DURONE NERO I	x	x	x		x				4
Lapins	x	x	x		x	x		x	6
Regina	x		x		x		x		4
Sweet Heart	x	x	x		x				4
MARGIT		x	x		x				3
Fertard	x				x	x			3
Folfer	x					x		x	3
Summit	x	x			x				3
Hedelfinger	x	x			x				3
Van	x	x			x				3
Vanda	x	x				x			3
Ferrovia			x	x					2



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Swiss Confederation
Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Education,
Research and Innovation SERI

Progress and future actions

- The project was initiated based on the needs of the fruit sector (breeders, variety testers/curators, farmers, etc.).
- Key issues and challenges were identified for each crop.
- Priority traits important to the organic sector and future climate change challenges were selected.
- Connection with existing networks (e.g. ECPGR, EUFRIN), valorising and integrating their achievements, is a key element of the project.
- C&E and passport data will be uploaded in templates compatible to EURISCO database
- To address the challenges of the organic farming system, there is a need to foster collaborations throughout the entire fruit production chain
- European participatory organic breeding and evaluation networks are being established.



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Thanks for your attention