

ECOBREED training event



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Funded by European Union
Horizon 2020
Grant agreement No 771367

ECOBREED training event

ECOBREED is an EU project in Horizon 2020 programme with 25 partners in 15 countries (universities, organic seed producers, plant breeding organisations, research institutes, agricultural/advisory organisations).

Duration: May 2018 – February 2024

Coordinator: Agricultural Institute of Slovenia



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Main focus is to improve availability of varieties and seed suitable for organic and low-input production.

Activities on 4 crops: wheat (common wheat, durum, a little bit perennial wheat)

Soya

potato

common buckwheat



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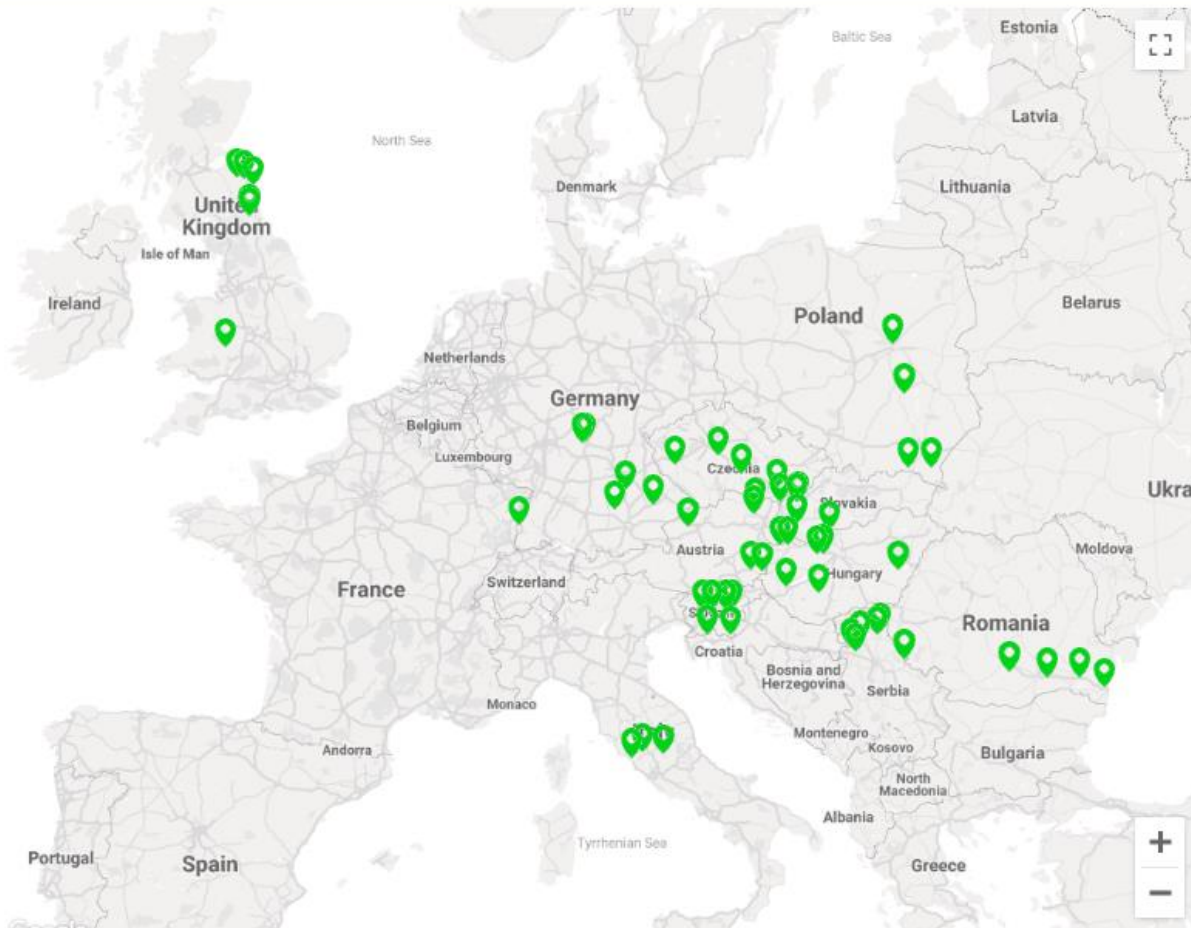
FARMER PARTICIPATORY TRIAL (FPT) DATABASE

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Farmers participatory field trials 2021 and 2022 (2023)

4 – 6 farmers per country

8 – 12 genotypes

100 x 3 meter stripes

Separation to 2 x 50 metres can be done for a treatment



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Farmers participatory trials 2021 and 2022

Wheat: UK, AT, SK, IT/RS

Buckwheat: UK, CZ, SI

Potatoes: PO, HU, SI

Soya: DE, RS, RO, AT/SI

Also composite cross populations.

Additional training and demonstration events.

Publications of the results in a bulletin.

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ECOBREED approach to participatory plant breeding (PPB)

Farmers with participatory trials (FPT).

Cooperation between farmer and researchers.

Integration of stakeholders.

Scoring of the varieties under „real life“ conditions of the farms.

Robust data management system.

Data collection can be done either by researchers or farmers.



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ECOBREED approach to participatory plant breeding (PPB)

Participatory plant breeding (PPB)

- Composite cross populations of wheat, soya and buckwheat.
- Farmers can start selection.
- Farmers can continue working with the populations after project.
- Potatoes: New early material is compared with existing varieties on the farms.



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ECOBREED approach to participatory plant breeding (PPB)

Participatory plant breeding (PPB)

Definitions:

Organic breeding (EU organic standards)

Breeding for organic agriculture

Variety

Population variety

Population

Variety mixture



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Organic Seed = Organic Variety?

No.

If a variety is called “organic” it should come from an organic breeding programme.

There is some misuse with the term “organic variety”.

In the EU regulation 848/2018 there are some chapters about populations = organic heterogenous material.



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Organic Variety = Organic Heterogenous Material

No

Organisches heterogenous material is a composite cross population.

Organic varieties can be registered under an experiment for wheat, maize, barley, kohlrabi and carrots in DUS-test with less criteria.

Problem: Loss of variety protection?

What happens to organic VCU?



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Do we need organic plant breeding?

Yes, sooner or later.

1. It depends on the difference in production systems between conventional and organic in that crop in a certain region. In most cases the production systems have the tendency to become more different but also the opposite scenario is existing (depending on politics).



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Do we need organic plant breeding?

2. We need organic breeding if the breeding methods turn to be unsuitable for organic agriculture (genetic modifying, protoplast fusion, Crips-Cas and others).



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Wheat: What are important traits for you?

Trait	Yes	No	I am not sure
Yield			
Yield stability			
Quality			
Disease resistance, examples			



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What could be different traits for organic compared to conventional farming in your region?

Trait	Reason	Yes	No	I am not sure
Yield	Less nitrogen			
Yield stability	Varieties			
Plant height/weed suppression	No herbicides			
Backing quality	Less nitrogen			



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Uniform varieties lines vs populations

Seed companies like to breed varieties that perform well at many places because license fees that they need for breeding will be higher then

A population works with adaption to the region and it is not necessary that it performs well at every location. In the most extreme case it only works on one farm.

Hybrids: Use of farm saved seed does not work well.



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Farmers participatory field trials

CZ 2020/AT 2021

	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius	
Gaspoltshofen	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius	
harvest yield	dt/ha	54,5	52,5		56,3	53,8	51,4	38,1				37,8							
protein	perce	10,3	10,3		9	9,3	9,5	9,7				8							
protein yield	kg	561	551		505	500	488	370				302							
Starnwörth	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius	
harvest yield	dt/ha	63,7	78,3			68,1	79,3	92	69,6	74,5									
protein	perce	12,9	12,2			12,5	12,7	13	11,3	13,4									
protein yield	kg	848	955			851	1007	1196	786	998									
Aspersdorf	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius	
harvest yield	dt/ha	74,9	71,2		74,8	63	76,4		73,8			71	89,5	75,8	64,2	68,7			
protein	perce	14	13,5		13,1	13,1	12,5		13,1			12,2	12,8	12,7	13,4	13,7			
protein yield	kg	1049	961		905	825	955		1114			866	1145	963	860	941			
Wallern	140 kg	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius
harvest yield	dt/ha	41,2	31,3	31,5					42	42	37,8	33,5			35,7	35,7	42	43,9	33,5
protein	perce	11,9	12	11,7					12,2	10,8	11,6	12,3			11,8	11,3	11,4	12,1	12,1
cellulose	ml	39	62	62					66	57	63	62			60	58	62	63	62
gluten	perce	29,8	31,9	30,7					31,7	29,3	30,9	31,1			30,3	29,5	30,7	32,6	30,6
protein yield	kg	490	376	369					512	454	438	412			421	403	479	531	405
PROBIO 2020	Capo	Allesio	Wende	Furino	Viki	Liochar	IS Laud	PS Dobi	MV elit	Arminiu	Bernste	MV Kol	Lennox	Edelma	Ehogol	Arnold	Adamu	Aurelius	
harvest yield		40,8	42,6	43	33,3	34	30	33,2	29,2	30				32,3	31,1	42,6		43,4	
protein		13,5	14,9	13,5	13,7	13,5	14,9	13,9	13,2	16				13,6	13,8	15		14,6	
protein yield		632	634	667	456	459	447	538	404	480				504	429	639		634	



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Farmers participatory field trials

CZ/AT 2022

Wallern	Alicantus	Arminius	Arnold	Aurelius	Blickfang	Capo	Christoph	Edelmann	Ehogold	Energ	Izalco CS	Mv elit	Mv Pantilika	Mandarin	
dt/ha (14% m	41	43,6	47,4	55,2	26,9	47,4	56,4	46,2	43,6	50,1	35,8	29,4	29,5	43,5	
percent, DM	14,8	15,6	15,3	14,5	11,3	14,5	13,7	13,5	15,9	14,8	14,9	10,1	9,2	14,2	
kg/ha	607	680	725	800	304	687	773	624	693	741	533	297	271	618	
Aspersdorf	Aristaro	Arminius			Blickfang	Capo		Edelmann	Lennox	Liocharls		Mandarin	Wendelin		
dt/ha (14% m	47,6	48,9			58,8	54,3		48,9	60	50,2		52,8	51,7		
percent, DM	11,3	11,4			10,3	11,3		10,4	10,6	11,6		11,4	11,2		
kg/ha	538	557			606	614		509	654	582		602	579		
Starnwörth	Aristaro	Arminius	Alessio		Blickfang	Capo	Christoph	Edelmann				Mandarin	Wendelin		
dt/ha (14% m	59,6	66,6	51		62,5	65,9	57,5	61,1				61,4	66,2		
percent, DM	10,6	9,7	9,4		9,4	9,3	9,6	9,6				8,2	10,2		
kg/ha	632	646	479		587	613	552	587				503	675		
Gaspoltshofen		Arminius			Blickfang						Liocharls	Lukullus	Rübezahl	Wendelin	Purino
dt/ha (14% moisture)		64,4			66,4						55,7	67	57	49,1	52
percent, DM		12,1			11,5						11,5	11,7	9,9	12,4	12,8
kg/ha		779			763						640	784	564	609	666
Velke Hoster	Scaro	Penepole	Alessio	LG Orlice	Lorien	Poeise	Butterfly	Prim	Royal	Liocharls	Centurien	Mv elit	Wendelin	Wiwa	
dt /ha (14% m	25	25	31	28	31	28	28	25	28	27	31	28	25	25	
percent, DM	15,7	15,1	15,3	13,4	13,7	15,3	15,8	16,9	15,1	15,2	13,2	15,3	16,5	16,5	
kg/ha	393	378	474	375	425	428	442	423	423	410	409	428	413	413	

EU-PROJEKTE (NATURLAND E.V.) ECOBREED UK 2020-21



Wheat 2020 UK													
Thornton farm 2020													
sowing density	KWS Extase	Alessio	Wendelin	Purino	Viki	xxx	Revelation	Royal	Wakelyns	Barranco	Wiwa	KWS Zyatt	Roderik
harvest yield	dt/ha	58,9	37,8	47,3	37,1		45,8	41,6	47,5	34,8	28,6	49	
Thornton farm 2021													
harvest yield	dt/ha	118	97	105	92	97	98	117	100	97	95		91
protein	percent	9,9	12,6	13,6	12,8	12,5	13,3	11,2	11,3	11,8	10,9		12,6
protein yield	kg	1168	1222	1428	1241	1213	1303	1310	1130	1145	1036		1147
Nisbett Hill 2021													
harvest yield	dt/ha		71	71	61		79	71	70	63			51
protein	percent		12,1	12,5	12,6		12,1	11,3	11,2	12,9			14,4
proteinyield	kg		859	888	769		956	802	784	813			734
Newland 2021													
harvest yield	dt/ha	95	63	48,5	62,9		64	52	62	62			58
protein	percent	9,6	12,5	12,9	11,7		10,5	11,2	11	11,1			12,1
protein yield	kg	912	788	626	736		672	582	682	688			702
Gilchester 2021													
harvest yield	dt/ha		52	55	54	46	52	54	44	53	34		
protein	percent		13,8	13,9	13,1	14,1	14	12,1	12,9	12,7	13,3		
protein yield	kg		718	765	707	649	728	653	568	673	452		

EU-PROJEKTE (NATURLAND E.V.) ECOBREED UNGARN 2021



Ungarn 2021						
Csoroszló Farm	MV TARSOLY	MV MENROT	MV PANTLIKA	MV UNCIA	MV ELIT CCP	MV-BIO2020
harvest yield	76,1	67,8	65	75,7	71,4	85,8
protein	14,45	12,3	13,03	12,98	15,3	13,65
protein yield	1096	834	845	983	1092	1167
Füzesgyarma	MV TARSOLY	MV MENROT	MV PANTLIKA		MV ELIT CCP	MV BIO2020 POP
harvest yield	21,4	23,5	28,9		22,2	23,4
protein	14,6	11,8	10,1		14,7	14,7
protein yield	312	277	292		326	345
Biocentrum	MV TARSOLY	MV MENROT	MV PANTLIKA	MV UNCIA	MV ELIT CCP	MV BIO2020 POP
harvest yield	55	60	54	47	54	56
protein	13,7	12,1	13,3	13,6	13,7	13,2
protein yield	753	726	718	639	740	739

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source: Dottenfelder Hof, 2019

Variety/ population	Yield rel (dt/ha)	Wet gluten (%)	Sedi SDS (ml)	Falling number (S)	Baking volume (ml)
Julius	104	95	91	103	
Genius	106	95	101	107	98
Butaro	90	110	108	91	103
VRS abs	51,6	27,0	59	335	675
Liochalrs pop	101	102	102	91	98
Brandex pop	102	99	101	89	97



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Do we need organic plant breeding?

Bulletin

Publication of the results

Ecobreed Farmers Participatory Field Trials

Ecobreed.eu

ISBN 978-961-6998-65-9 (PDF)



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Plant breeders' rights

Plant breeders' rights are the rights that give the plant breeder the exclusive control over the propagation of his variety for a number of years, often 20 or 25 years.



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Plant breeders' rights

The variety has to be new and has to fulfil the DUS criteria.

- Distinct: distinct from all other known varieties in at least one botanic characteristic, such as plant height.
- Uniform: characteristics are the same on all plants.
- Stable: Characteristics have to be stable from generation to generation.



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Plant breeders' rights

DUS criteria have to be proofed in a registration process that lasts 2 or 3 years.

For some crops in this registration process the VCU (value for cultivation and use) criteria have to be fulfilled. At least one characteristic, e.g. disease resistance, must be better than the varieties already registered.

For some smaller crops, e.g. buckwheat, protection is possible without registration process.



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Plant breeders' rights

The breeder must give the variety a name that has to be used by anyone who markets the variety.

In some countries the registration process can be done under organic conditions for some crops.



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Plant breeders' rights

Exemption:

Breeders may use protected varieties to create new varieties and for research purposes.

Patents could hinder this.

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Farmers' rights

Farmers may multiply protected varieties for their own seed use

- if the crop is on a positive list
- If the breeder does not prohibit this in a private contract with the farmer.
- If the farmer pays a fee for the case this is agreed on.

A farmer must not sell seed of a protected variety to another farmer.



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Farmers' rights

Rights of farmers to save, use, exchange and sell farm-saved seeds

Restricted for protected varieties.

Farmers' activities will concentrate on old varieties (after protection) and populations.



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Conservation varieties

Conservation varieties (old varieties) can be registered but not protected.

For conservation varieties the amount of seed that is sold can be limited on national level.

Some criteria on seed quality have to be fulfilled.



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Populations

Populations can be registered since 2022 but cannot be protected.

Therefore legal sale of seeds is possible (before only under contract base)

Populations need to have a high grade of heterogeneity.



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Populations

Selection: There is a natural selection, but also selection by the breeder should be done.

E.g. negative selection of plants with diseases.

If you mix several varieties of a cross-pollinated crops they will develop to a population.



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Alternative systems like “open source seed licence”

- There is a development of alternative systems for seeds like the initiative „open-source-seed license”.
- The variety is free but the user has to agree that it stays free and also the offspring stays free. A variety for this system needs registration.



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Do I need to breed? Saving

If a variety is your favorite and it is not on market and not protected anymore for some years you can save the variety.

If you want to sell seeds the variety can be registered a conservation variety.

Amount of seed for sale can be restricted by national authorities.



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Do I need to breed? Saving

For maintaining a varieties it is necessary to use smaller part of the field or plots for careful observation.

Plants with unwanted characteristic and plants with diseases should be eliminated.

In a cross-pollinated crop like rye you will have much more unwanted characteristics like very long straw. Seed quality has to be checked every year.



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Do I need to breed? Saving

Good examples for very popular varieties in organic agriculture withdrawn from variety list because of loosing protection are winter wheat “Capo” or winter rye “Danko”.

But also varieties are withdrawn from market although still having protection because the breeder wants to sell a newer variety.

In this case talk to the breeder.



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Do I need to breed? Selection of populations

Selection is an activity that a farmer can do. Populations will develop naturally but it will be necessary to select.

The key for the population is the choice of parents. The offspring will stay in the frame given by the parents.

Again use a smaller part of the field or plots for careful observation.



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Do I need to breed? Selection of populations

As the experiment for populations has started few years ago and it was limited to the crops wheat, barley, oats and corn there is few knowledge on populations in Europe.

Wheat populations from UK, Germany and Hungary have been developed and are already part of ECOBREED trials. So we will get some knowledge about these populations.



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Do I need to breed? Crossing

If you do not like all available varieties you have to start crossing or building up a population in case of a cross-pollinated (or partly cross-pollinated) crop.



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Basic terms of breeding

Know your crop's method of reproduction

Self-pollinated crops

The flowers of self-pollinated crops have evolved strategies to exclude pollen from other flowers to prevent cross-pollination.

So the offspring is identical to their parents.



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Basic terms of breeding

Know your crop's method of reproduction

Self-pollinated crops

Self-pollination does not require wind or insects and you will know the traits your offspring will get.

It is easier to maintain a self-pollinated crop.

Nevertheless, there is always a small percentage of cross pollination.

Examples for self-pollinated crops are wheat and barley.

Videos about crossing are available in the internet



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Basic terms of breeding

Know your crop's method of reproduction

Cross-pollinated crops

Cross pollination is the opposite of self-pollination. The offspring is genetically different from each parental plant.

It is much more difficult to make a cross pollinated crop homogenous.

You need much more distance or effort for isolation.



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Basic terms of breeding

Know your crop's method of reproduction

Cross-pollinated crops

But the central advantage of cross-pollinating plants is that they can adapt to different environments.

An example for a cross pollinated crop is rye. There are also crops with having both self-pollination and cross pollination, e.g. fava beans.



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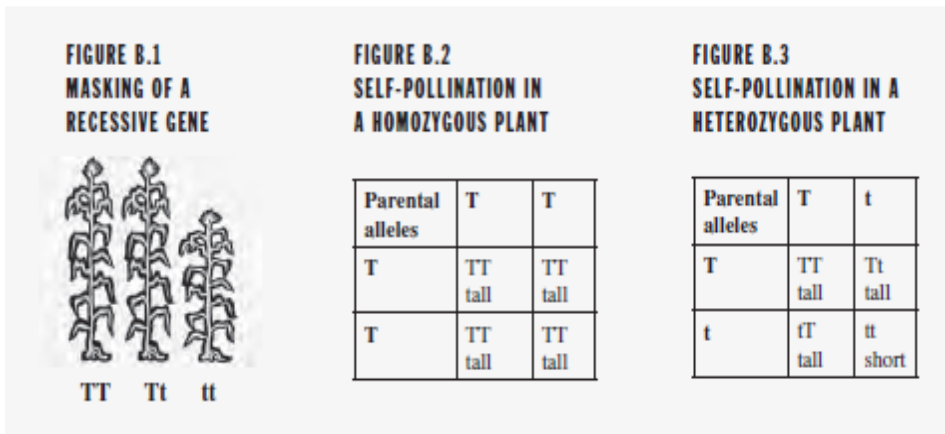


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Basic terms of breeding Dominant and recessive genes

Recessive genes can be masked and can appear by crossing if they are heterozygous. There are these possible combinations.



Source: R. White, B. Connolly, 2011



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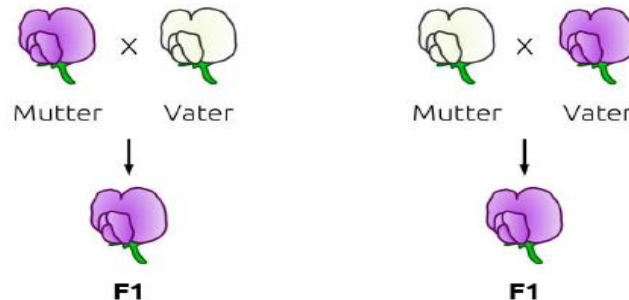
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Basic terms of breeding

Mendel's rules

Rule of uniformity:

The first offspring (F1) of a cross between two homozygous lines is uniform



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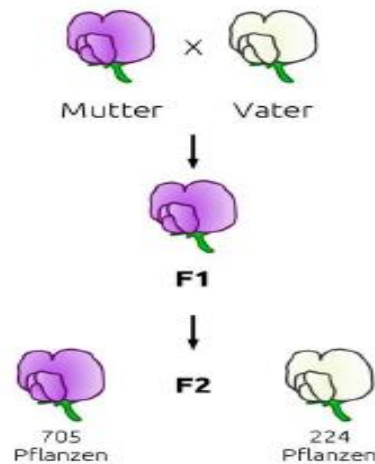
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Basic terms of breeding

Mendel's rules

Rule of segregation

F2 generation of F1 crossings show parents' traits in certain relation (3:1)



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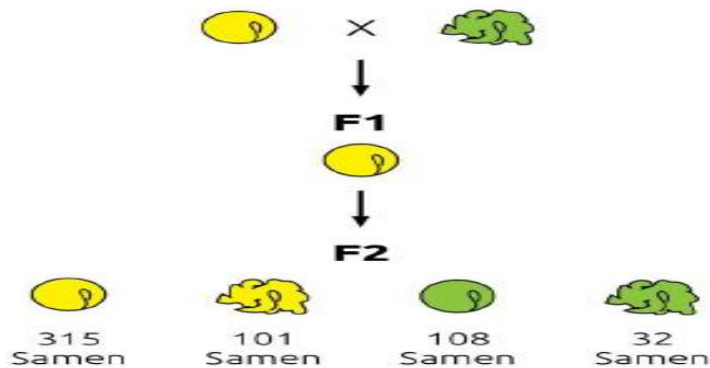
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Basic terms of breeding

Mendel's rules

Rule of independent assortment

Genes are inherited independently. New combinations can occur that did not exist in parents or F1 generation



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Scoring

The most important job during the trials is scoring of characteristics e.g. diseases, length, maturity, is often done with numbers from 1 to 9.

Generally, 1 means low, short or early. 9 means high, long or late.

Dates also can be expressed with days after sowing.



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Scoring wheat

Important traits for phenotyping

See attached ECOBREED phenotypic DMS for partners

Winter hardiness: Count 4 rows with one meter before winter and after winter. Mark with a small rod to count the same rows after winter.

Ground cover: Record BBCH growth stage

Heading: Date of BBCH GS55

Plant height: Record date at flowering GS62



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Scoring wheat

Lodging

Maturity: date of possible harvest

Grain yield

Insects

Diseases that appear, see attached ECOBREED phenotypic DMS for partners

Plus

Tilletia caries (common bunt) and *Tilletia controversa* (dwarf bunt)



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Scoring wheat

Tilletia caries (common bunt) and *Tilletia controversa* (dwarf bunt)

Check ears between one and two weeks before harvest. Most affected plants are little bit shorter, have a greener colour (not black) and the ears look scrubby. Instead of a seed you will find black spores smelling like fish. Plants with dwarf bunt are shorter.



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Scoring wheat

Tilletia caries (common bunt) and *Tilletia controversa* (dwarf bunt)



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Scoring wheat

Variety	Rep 1	Rep 2	Rep 3	Rep 4	Average
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					



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Add data from phenotypic DMS of partners, especially pictures for scoring.



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