van Waveren Saaten GmbH

Breeding Challenges in the Shadow of Climate Change
Pea and Sweet Corn under Increasing Heat and Drought Pressure

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Plant breeders
since 1898

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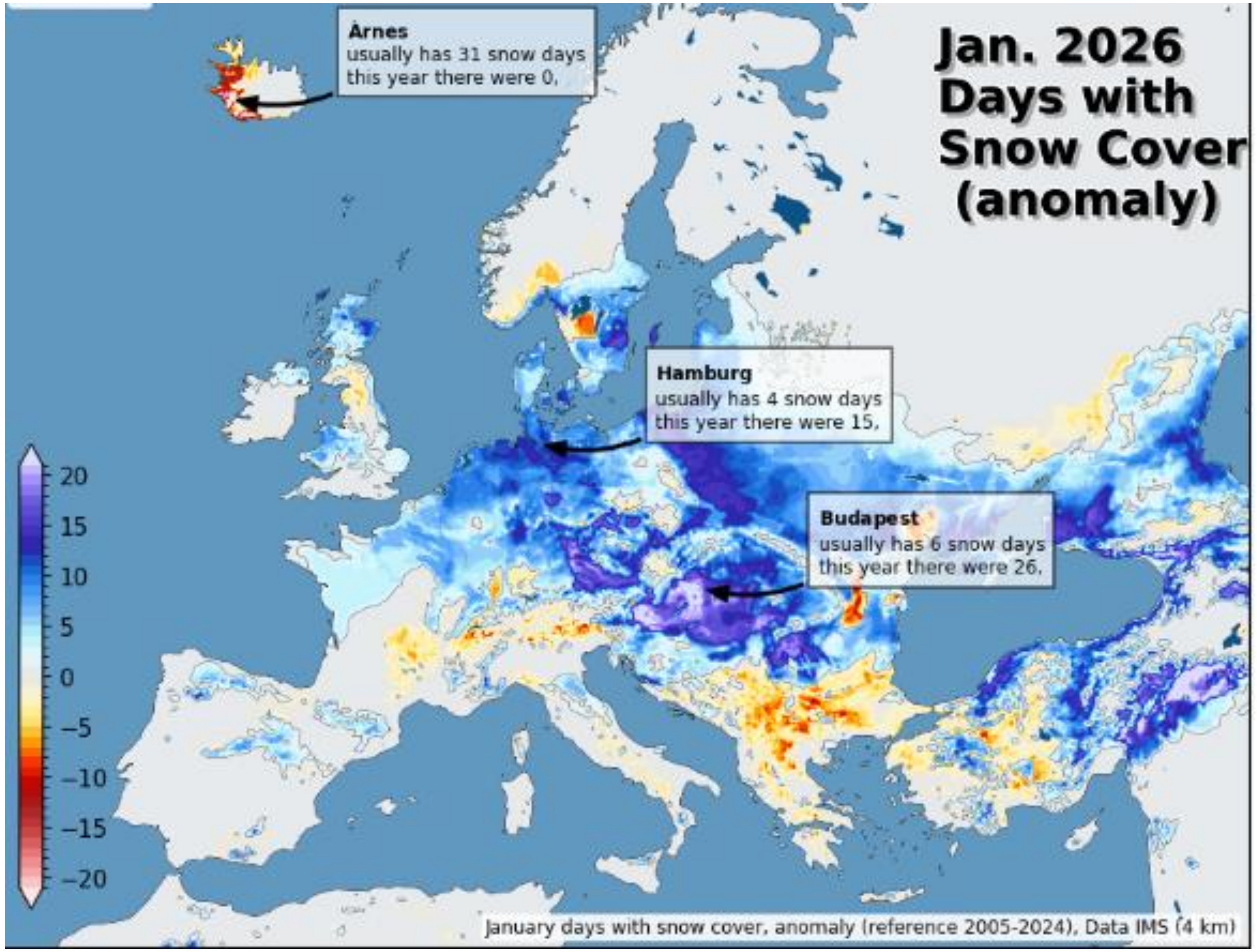
Breeding Challenges in the Shadow of Climate Change
Pea and Sweet Corn under Increasing Heat and Drought Pressure

1. Climate change in Central Europe
2. Biological impact of heat & drought
3. Breeding strategies and limitations
4. Market requirements shift
5. Genetic reserves in pea & sweet corn
6. Agronomic leverage
7. Strategic outlook

1. Climate change –> just FAKE NEWS?

https://edition.cnn.com

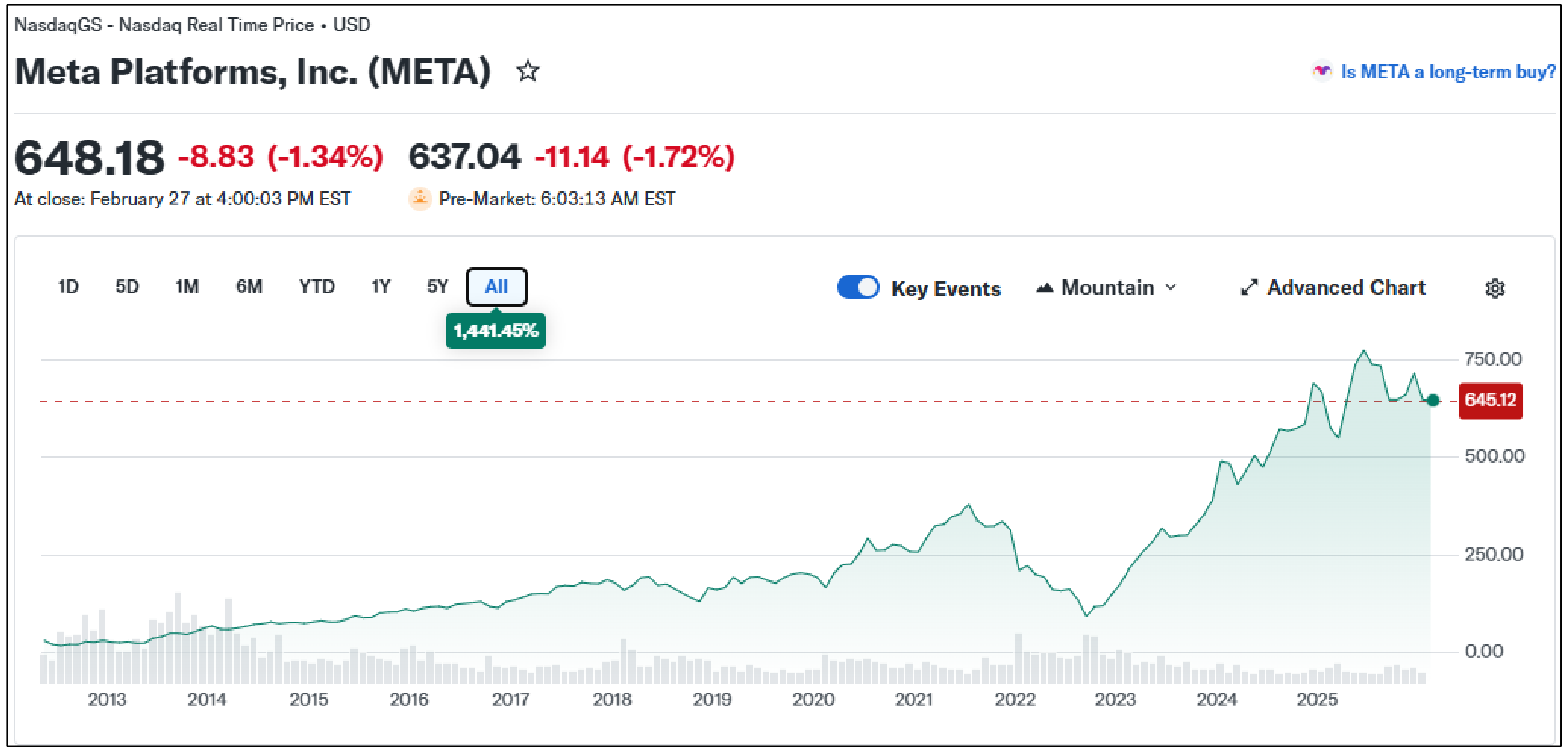
https://www.nytimes.com/live/2026/02/23/weather/nyc-snow-storm

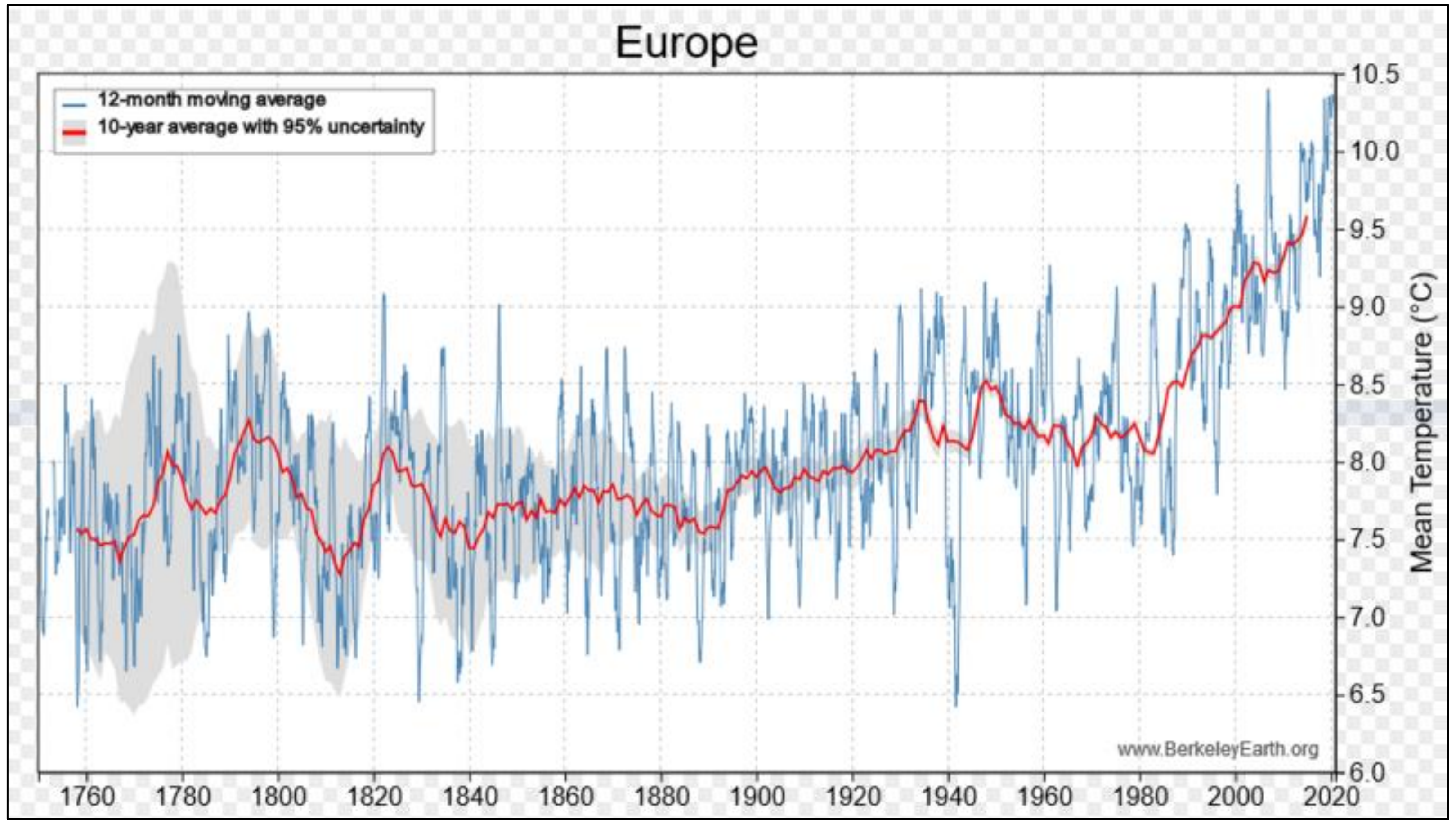


https://guidocioni.substack.com/p/january-2026-more-snow-days-in-budapest

1. Climate change

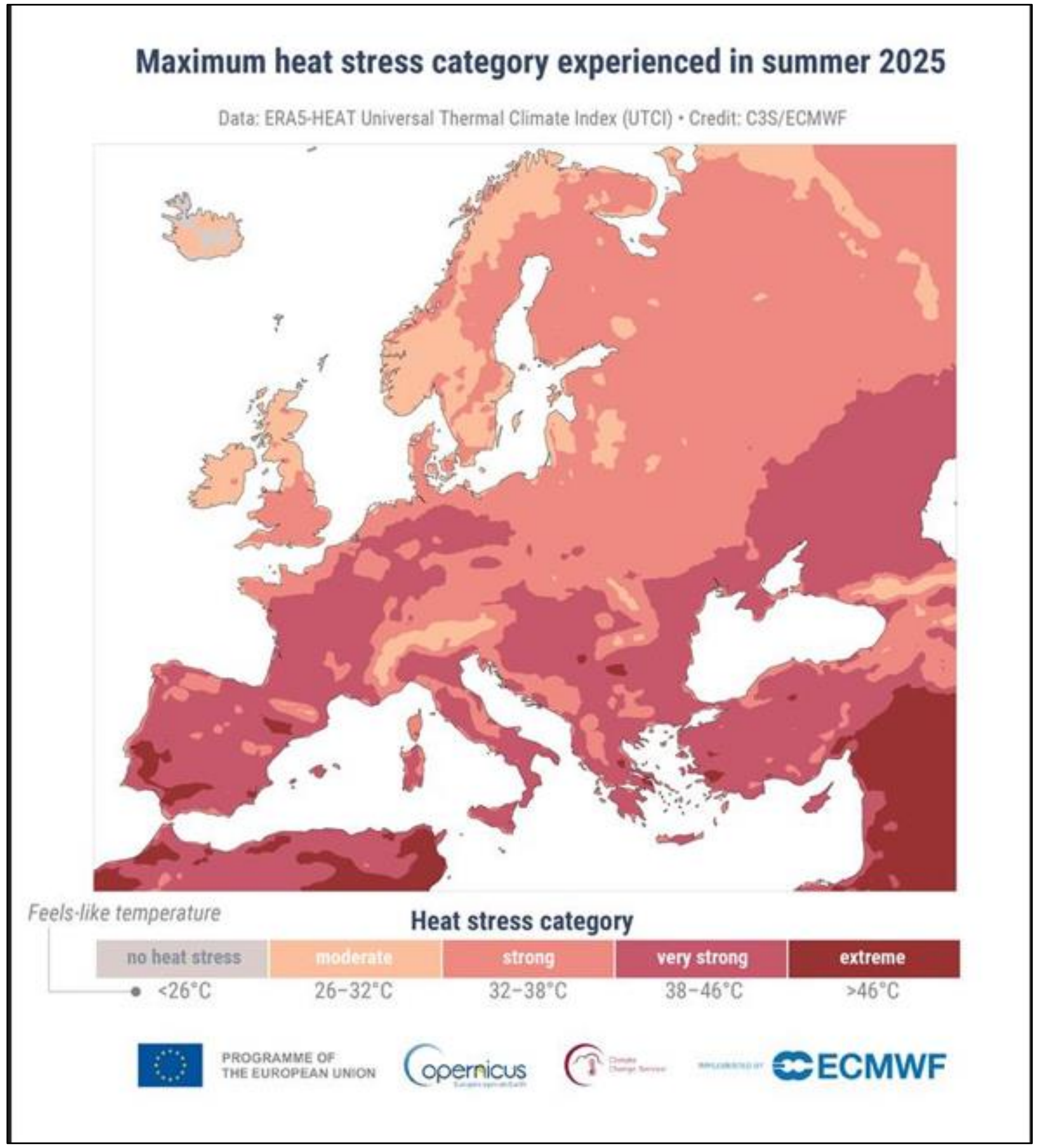
Trend (definition): `In statistics, a trend refers to the long-term change in data within a time series, which is assumed to be sustained and **proceed in a specific direction.** Trends are important for identifying developments that extend **beyond short-term fluctuations** and are frequently used in economics or climate research to generate forecasts and make informed decisions.´

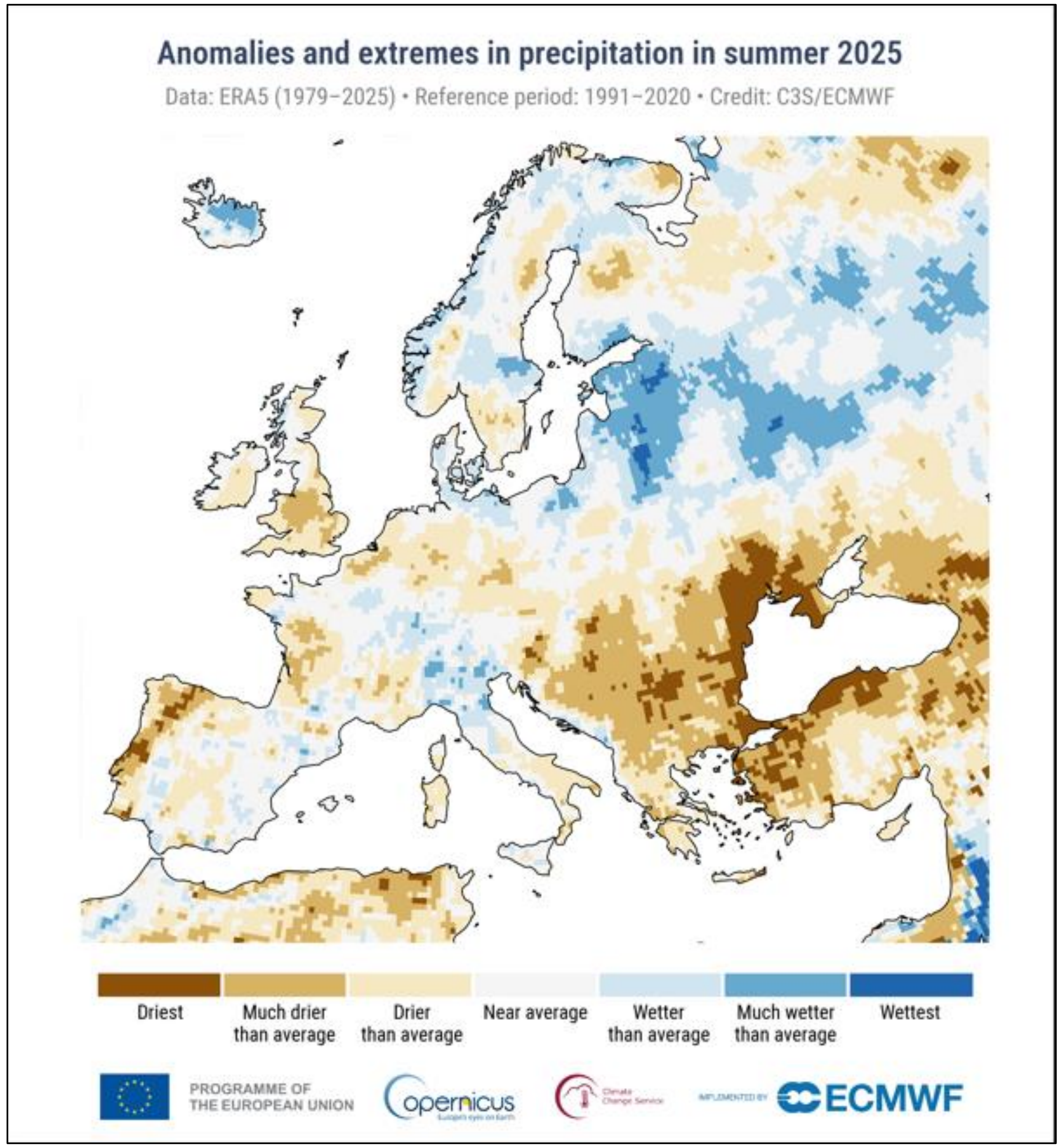


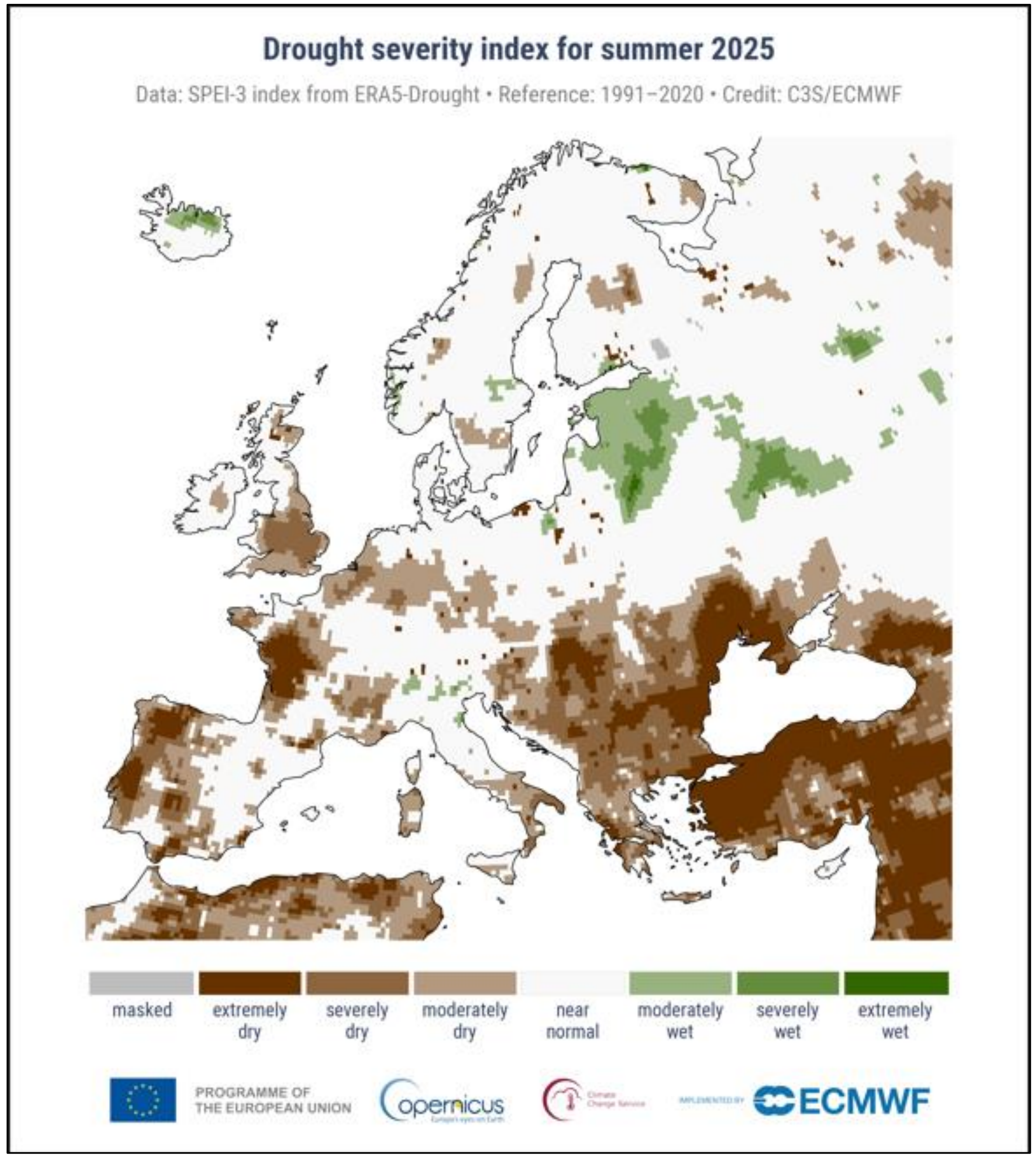


1. Climate change -> is for real!

- More frequent heat waves (>35°C) / higher temperature during flowering
- Unpredictable precipitation
- more severe / longer drought periods







https://climate.copernicus.eu/european-summer-2025-hot-west-and-south-dry-southeast

2. Biological impact of heat & drought

Heat stress:

- denatures proteins and disrupt metabolic pathways
- reduces photosynthesis and pollen fertility
- respiration is increased
- water use efficiency is decreasing

Drought stress:

- stomatal closure
- decreased photosynthetic performance
- Impaired transport of assimilates

https://www.agweb.com/news/crops/early-drought-stress-corn-tips

2. Biological impact of heat & drought

Crops are particularly sensitive during flowering and reproductive stages:

- impairment of pollen viability results in a direct failure of pollination

- the metabolism of stressed plants is increasing, plants are running out of nutrient storage, especially when during the nights there is also no stress relief (`tropical nights´), -> pollinated flowers and fruits are dropped to conserve resources for survival of the plant

- Stressed plants transit into a survival mode, most flowers and fruits are sacrificed for the viability of few offspring

both stressors often occur together and cause **non-linear yield loss by feedback loop**
e.g.: higher temperature -> higher respiration; higher respiration -> water shortage; water shortage -> lower respiration; lower respiration -> higher temperature; higher temperature -> **STRESS**

3. Breeding strategies and limitations

Plants respond to heat and drought stress by three primary strategies:

- **Escape** allows a plant to complete its life cycle before heat becomes critically high or supply of water critically low (-> by early sowing [cold tolerance!]; -> by early matuarity; relevant for peas!)

- **Tolerance** refers to the ability of resilient plants to maintain physiological functions under suboptimal temperature or water supply conditions by taking advantage of e.g. certain protective proteins and/or osmotic adjustment (complex!)

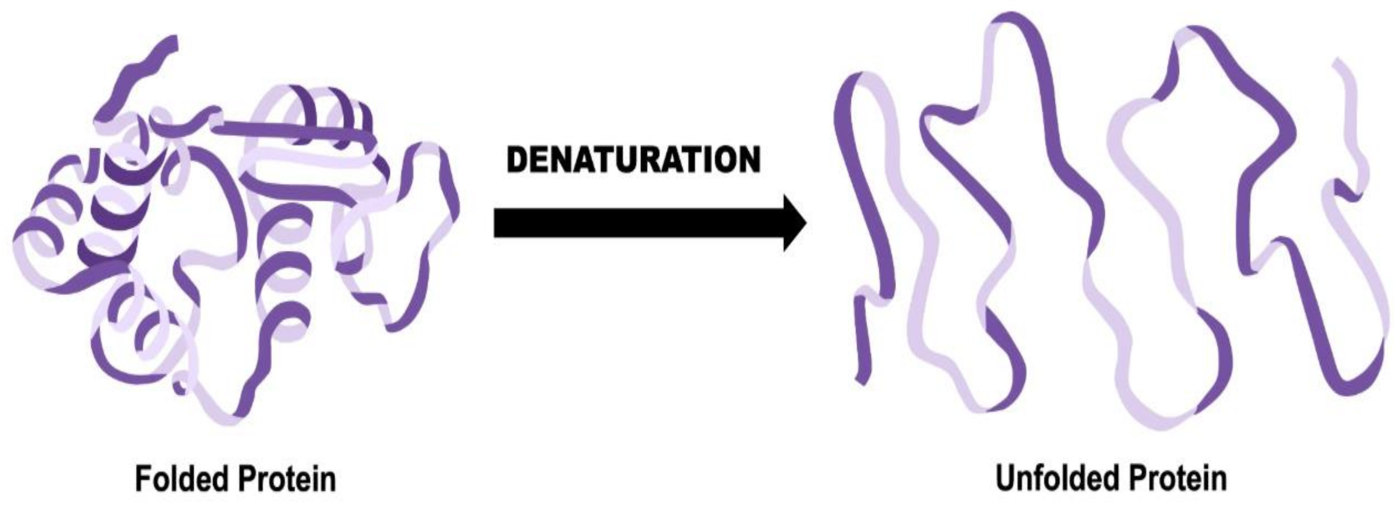
- **Avoidance of heat** involves physiological changes that minimize the effect of the heat by leaf movement or cooling down the temperature within the canopy, whereas **drought avoidance** tries to minimize water loss, maximize water uptake or optimize water usage (prolific rooting; tap roots)

3. Breeding strategies and limitations

Plant breeders are breeding for tolerance to heat and drought stress by looking for traits associated with these primary strategies.

Breeding for combined heat and drought tolerance is more complex due to sometimes opposite strategies for the respective stressors (e.g. cooling down the temperature vs. stomatal regulation)

Breeding for heat stress tolerance has natural limitations! At a certain temperature the three-dimensional structure of proteins simply unfolds and the biological activity is destroyed



https://ib.bioninja.com.au/denaturation/

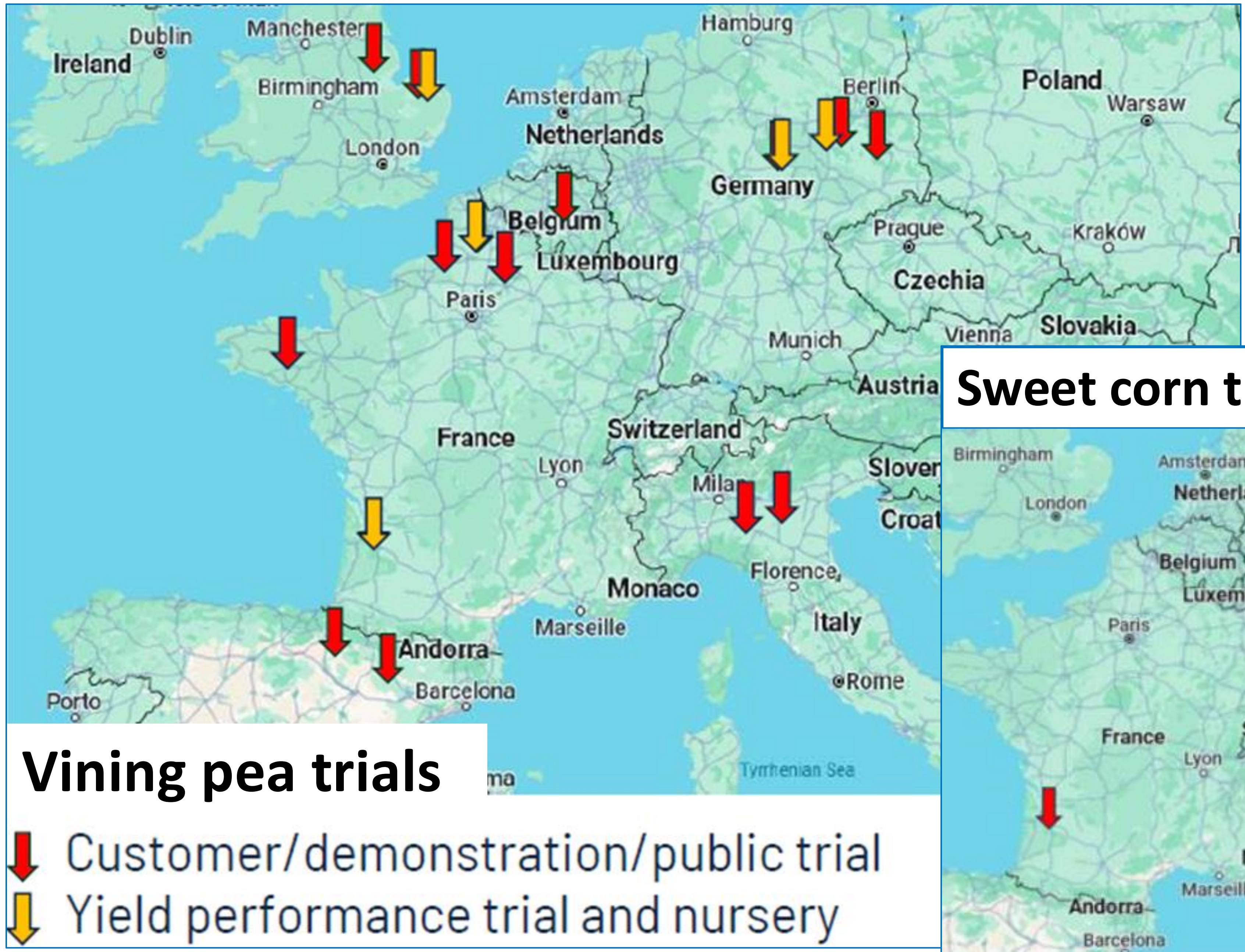
Most proteins begin denaturing near 40°C; for pollen it is even lower (33-37°C)

In some areas of the world even extensive watering wouldn´t help; Heat wave 2018 with almost 40°C for several days in a row in the area of our breeding station: watering didn´t help

3. Breeding strategies and limitations

Classical breeding relies on phenotypic selection under multi-locational (artificial) stress environments and testing genotypes across diverse environments

- ➔ Identify resilient material with with stable genotype × environment interaction
- ➔ Combination breeding with known tolerant lines
- ➔ Selection for yield stability rather than maximum yield (e.g. CD SEED-project in Ethiopia; -> European high yielding barley varieties had severe problems with the local conditions)



3. Breeding strategies and limitations

Classical breeding could be supported by **Marker Assisted Selection**

➔ with known markers associated with heat / drought tolerance traits relevant plant ressources could be identified at an early stage and selected for further development

➔ traits are complex, markers explain often just small fraction of phenotypic variance to abiotic stressors

Genes (Basel). 2021 Nov 26;12(12):1897. doi: 10.3390/genes12121897.

Genome-Wide Association Mapping for Heat and Drought Adaptive Traits in Pea

Endale G Tafesse [1], Krishna K Gali [1], V B Reddy Lachagari [2], Rosalind Bueckert [1], Thomas D Warkentin [1]

Affiliations + expand

PMID: 34946846 PMCID: PMC8701326 DOI: 10.3390/genes12121897

Quantitative trait loci associated to drought tolerance in pea (*Pisum sativum* L.)

Iglesias-García[1] R., Prats[1] E., Fondevilla[2] S., Satovic[3] Z., Rubiales[1] D.

[1] *Institute for Sustainable Agriculture, CSIC, Apdo. 4084, 14080 Córdoba, Spain.*

[2] *University of Frankfurt, Institute for Molecular Bioscience Max–von Laue Str. 9, D–60438 Frankfurt am Main, Germany.*

[3] *Faculty of Agriculture, Department of Seed Science and Technology, Svetošimunska 25, 10000 Zagreb, Croatia*

Mol Breed. 2021 Jan 19;41(2):8. doi: 10.1007/s11032-020-01194-w

Genetic dissection of maize drought tolerance for trait improvement

Shengxue Liu [1], Feng Qin [1,✉]

Author information ▸ Article notes ▸ Copyright and License information

PMCID: PMC10236036 PMID: 37309476

BMC Plant Biol. 2023 Oct 6;23(1):468. doi: 10.1186/s12870-023-04489-0.

Molecular mechanisms of drought resistance using genome-wide association mapping in maize (Zea mays L.)

Zhang Ningning [1], Liu Binbin [1], Ye Fan [1], Chang Jianzhong [2], Zhou Yuqian [3], Wang Yejian [4], Zhang Wenjie [5], Zhang Xinghua [1], Xu Shutu [6], Xue Jiquan [7]

Affiliations + expand

PMID: 37803273 PMCID: PMC10557160 DOI: 10.1186/s12870-023-04489-0

3. Breeding strategies and limitations

While MAS is a foreground selection, relying just on few markers associated with a given trait, **Genomic Selection** takes advantage of genome-wide markers to predict breeding values

Genomic Selection involves four key stages:
Training population is genotyped and phenotyped; build the prediction model.
Prediction Model uses genomic data to estimate marker effects
Prediction of breeding values for selection candidates
Selection of top individuals to advance breeding cycles

- ➔ prices for genotyping has drastically dropped ☺
- ➔ GS needs strong and robust phenotypic data ☹
- ➔ High-throughput phenotyping is a solution! ☺

▸ Front Plant Sci. 2017 Apr 21;8:550. doi: 10.3389/fpls.2017.00550

Genomic Selection for Drought Tolerance Using Genome-Wide SNPs in Maize

Mittal Shikha [1], Arora Kanika [1], Atmakuri Ramakrishna Rao [2], Mallana Gowdra Mallikarjuna [1], Hari Shanker Gupta [1,3], Thirunavukkarasu Nepolean [1,*]

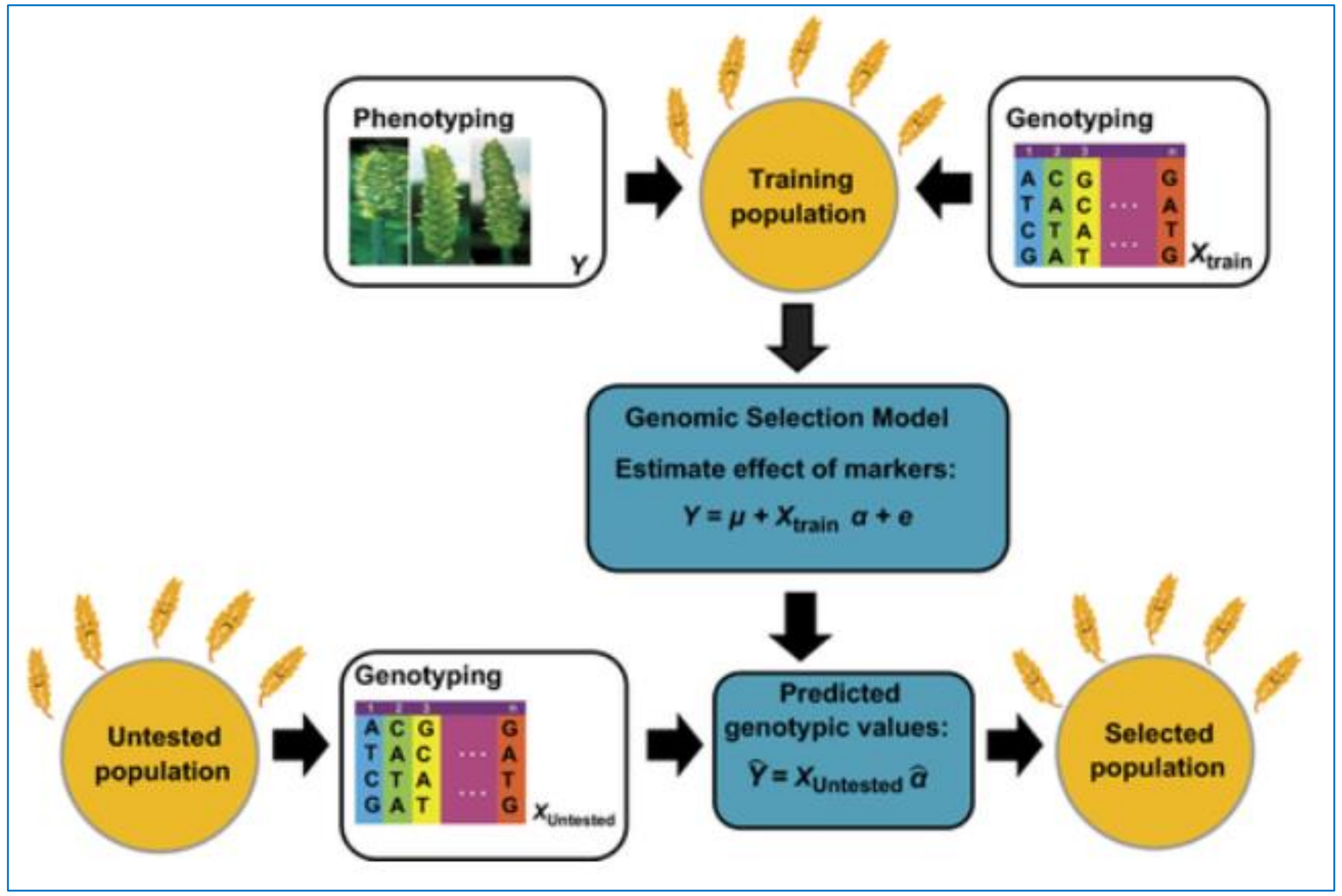
› BMC Genomics. 2019 Jul 22;20(1):603. doi: 10.1186/s12864-019-5920-x.

Pea genomic selection for Italian environments

Paolo Annicchiarico [1], Nelson Nazzicari [2], Luciano Pecetti [2], Massimo Romani [2], Luigi Russi [3]

Affiliations + expand

PMID: 31331290 PMCID: PMC6647272 DOI: 10.1186/s12864-019-5920-x



https://onlinelibrary.wiley.com/doi/10.1111/pbr.12231

3. Breeding strategies and limitations

New Genomic Techniques allow targeted modification of genes (`genome editing´) so that new traits and properties are produced in crops

By doing so the development of desired traits could be accelerated or even just be made possible

➔ not for all crops available for the time being
➔ extensive regulatory framework!
➔ market acceptance?

Curr Issues Mol Biol. 2022 Jun 8;44(6):2664–2682. doi: 10.3390/cimb44060182

CRISPR/Cas9 Technique for Temperature, Drought, and Salinity Stress Responses

Xiaohan Li [1,†], Siyan Xu [1,†], Martina Bianca Fuhrmann-Aoyagi [1], Shaoze Yuan [1], Takeru Iwama [1], Misaki Kobayashi [1], Kenji Miura [1,2,*]

OPEN ACCESS

Spanish Journal of Agricultural Research 23 (3)
July-September, 2025, 21503
ISSN-L: 1695-971X, eISSN: 2171-9292
https://doi.org/10.5424/sjar/2025233-21503

RESEARCH ARTICLE

Are consumers ready to accept gene-edited crops? Evidence from a choice experiment for CRISPR-edited tomatoes in Spain

Petjon Ballco[1,2*], Jesús Barreiro-Hurlé[3], Azucena Gracia[1,2] and Ana Isabel Sanjuán[1,2]

4. Market requirements are changing!

Industry	
Uniform maturity	Uniform cob size
Stable tenderometer values	High sugar content
Sweet taste	Slow sugar-to-starch conversion
Color retention	Color retention
Low field loss	Kernel uniformity
Mechanical harvest suitability	High recovery rate (cob-to-kernel)

Consumers & Retail

Sustainability	Quality	Reliability
Reduced inputs	Sweet taste	Year-round availability
Climate-resilient production	Tender texture	Consistent quality
Local sourcing	Color stability	Stable supply chain

At the same time in the field:

Climate change impact!!!

↓

1. Heat accelerates sugar degradation
2. Drought reduces kernel fill
3. Higher variability between fields

↓

Predictability over maximum yield!

5. Genetic reserves in pea & sweet corn

Peas:

➔ wide diversity in maturity is existing (almost 3 weeks within our portfolio)

➔ remarkable cold tolerance (Austrian winter Pea -12°C; new USDA-ARS-material: -20°C)

➔ variation within root system: The German pea cultivar (Hohenheimer Pink-Flowered; PI 180693) is renowned for its resistance to multiple root rot pathogens.
This resistance is due to a prolific root system!

➔ Certain pea accessions has shown high stability in yield components in both favorable and unfavorable late-season conditions

➔ In the past peas were a somewhat neglected crop when it comes to research; this has changed! So, more breeding progress could be assumed than for the already established usual suspects

5. Genetic reserves in pea & sweet corn

Sweet Corn:

➔ diversity in maturity is existing; early vigour is paramount for early field establishment

➔ (field) corn is a success-story with regard to the adaption of colder climate; until WW2 just in warmer regions of Europe; still rather sensitive to cold, especially at germination and early seedling stages; still progress with the identification of better adapted material

➔ in corn several QTLs for stay-green has been identified

➔ extensive research is done with regard to the root systems in corn

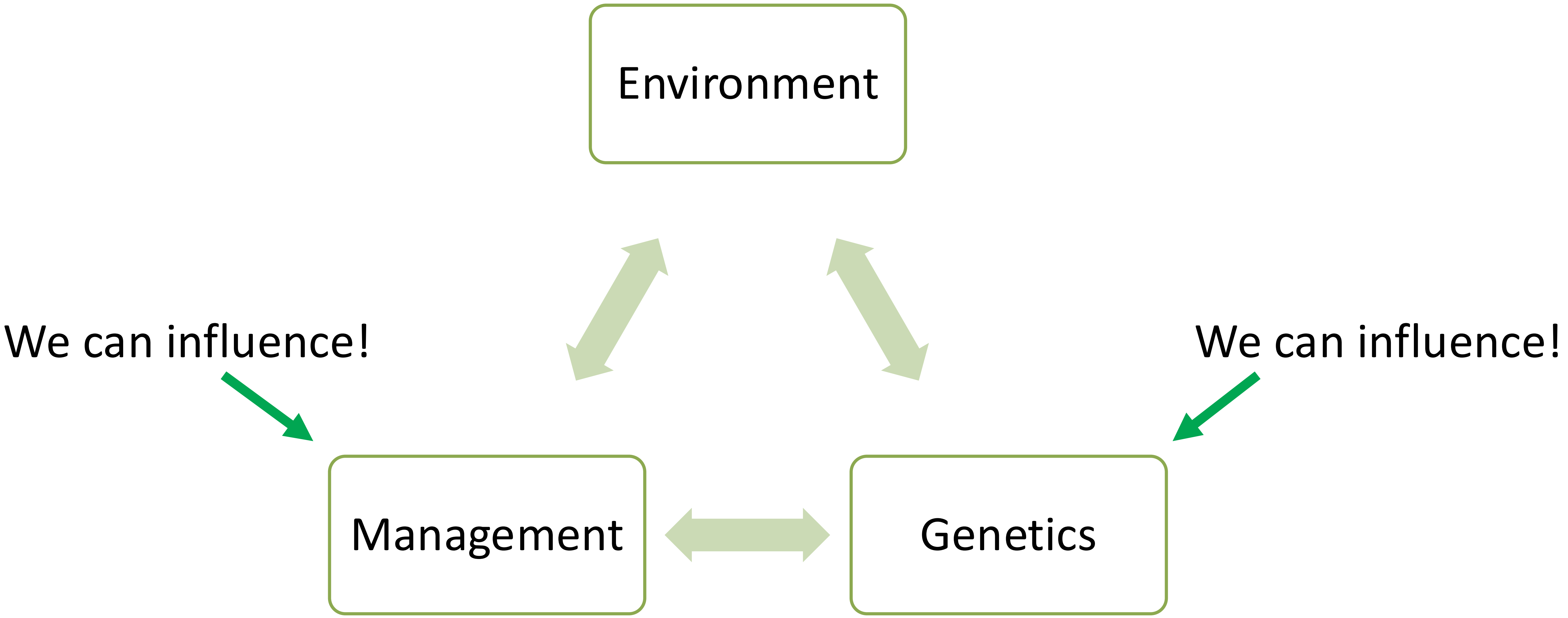
➔ (field) corn is no overseen crop at all! For this crop big breeding progress with regard to yield has been achieved in the past! So, stability is now in the focus!

6. Agronomic leverage

Side Fact
Public trials show higher yields every year – BUT yields on farms do not increase.

→

Breeding cannot compensate for poor agronomy and vice versa.



6. Agronomic leverage

Sowing strategy

- Early sowing
- Adapted maturity groups
- Harvest window planning

Yield & Quality Stability

Precision Agriculture

- Thermal stress detection
- Variable-rate irrigation
- Site-specific nitrogen management
- Pest management

Soil Management

- Improve soil structure
- Increase organic matter
- Improve water holding capacity

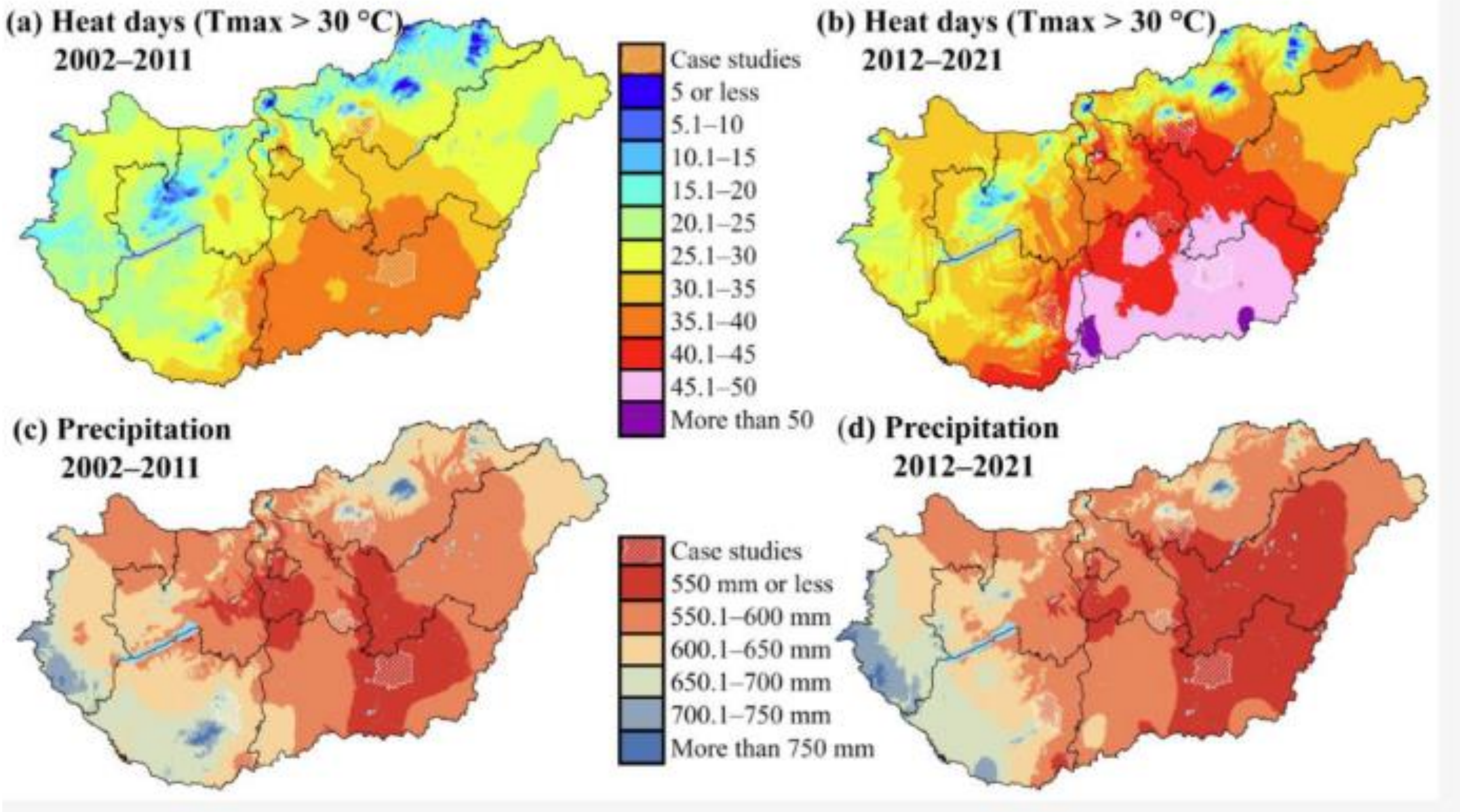
7. Strategic outlook

Outlook for Hungary

➔ Climate change is happening and Hungary is experiencing the effects of global warming even faster than other locations in Europe

➔ Droughts affected over 50% of Hungary's territory in 11 years from 1990–2023, hitting agriculture hardest with low river levels like the Danube at 6% capacity in 2025; rather low percentage of farmland is irrigated

Figure 4. Yearly average number of heatwave days (days with a maximum temperature of over 30 °C), 2002–2011 (**a**), 2012–2021 (**b**); and yearly average precipitation 2002–2011 (**c**) and 2012–2021 (**d**). Source: Own calculation based on data from the Meteorological Database of the Hungarian Meteorological Service.



Lennert et al. 2024: Climate Change, Pressures, and Adaptation Capacities of Farmers:

➔ Climate Hungary's average temperature has increased by about 1.15–1.23°C since the early 1900s, outpacing the global rise of 0.9°C, Heatwaves are more frequent and intense, including 40°C peaks in 2024, while projections suggest up to 3–4°C further rise

7. Strategic outlook

Outlook for Hungary

➔ Escape of drought and heat is paramount! So, early material, early sowing (of cold tolerant material)

➔ Selection of genotypes with better root system is also a promising approach, which is actually done en passant by selecting of the visible part of the plant

➔ Teaming up of breeding and agronomy! There are limitations which breeding alone could not bridge; e.g. if there is a certain lack of water even the most drought tolerant variety could not grow

"Climate change shifts our breeding objective from only maximizing yield potential to maximizing yield stability and quality reliability. The successful varieties of the future will not necessarily be the highest yielding in optimal years — but the most consistent across stressful years."

8. Köszönet!

Portfolio

VARIETY	LEAFTYPE	GROWTH CHARACTERISTICS				POD			% PEA GRADES (% sieve size in mm at TR 100 - 110)						SEED				RESISTANCES				VARIETY
		days to maturity relative to KISS	heat units (°C)	average height cm	nodes to 1st flower	number of pods per fertile node	shape of pods	peas per pod	I <7,5	II -8,2	III -9,3	IV -10,2	V >10,2	average	weight of 1000 seeds in g approx.	plant stand per m²	seed rate appr. kg/ha	seed rate units/ha	PEMV	Fop 1	Ep	Pv	
ALOHA	n	-1	660	65 - 70	9 - 10	2	pointed	7 - 9	2	5	36	44	13	3,6	220	110 - 130	240 - 280	11 - 13		HR		IR	ALOHA
ALVARIO (WAV 4120)	n	-1	665	65 - 70	10 - 11	1 - 2	blunt	7 - 9	4	11	36	38	13	3,5	195	110 - 130	215 - 255	11 - 13	IR	HR		IR	ALVARIO (WAV 4120)
KISS	n	0	675	70 - 75	9 - 10	2	blunt	7 - 8	2	6	37	50	5	3.5	210	100 - 120	190 - 250	10 - 12		HR		IR	KISS
BONFIRE	af	1	690	55 - 60	9 - 10	2 - 3	blunt	7 - 9	2	11	61	26	0	3,1	175	110 - 130	190 - 225	11 - 13	IR	HR		IR	BONFIRE
WINNER	n	1	695	60 - 65	9 - 10	1 - 2	blunt	7 - 8	6	10	36	38	10	3,4	200	90 - 110	160 - 220	9 - 11		HR			WINNER
CARGO	n	2	705	65 - 70	9 - 10	2 - 3	blunt	8 - 9	4	7	43	39	7	3.4	190	100 - 110	190 - 210	10 - 11		HR		IR	CARGO
CABALLERO (WAV 975)	af	3	705	70	11 - 12	2 - 3	blunt	7 - 9	5	10	37	39	9	3,4	190	90 - 110	170 - 210	9 - 11	IR	HR	HR	IR	CABALLERO (WAV 975)
FIORINO	n	3 - 4	715	65 - 70	10 - 11	3	pointed	8 - 9	5	27	45	23	0	2,8	160	90 - 110	190 - 210	9 - 11	IR	HR	IR	IR	FIORINO
STYLE	af	4	735	65 - 70	10 - 11	2	blunt	7 - 8	0	10	24	32	34	3.9	200	90 - 110	180 - 220	9 - 11		HR			STYLE
BELVEDERE	n	4	740	60 - 65	10 - 11	3 - 4	blunt	7 - 9	2	10	55	30	2	3,2	185	90 - 110	165 - 205	9 - 11	IR	HR		IR	BELVEDERE
SIENNA	n	4	740	55 - 60	10 - 11	2 - 3	blunt	6 - 8	1	5	24	51	19	3,8	220	90 - 110	200 - 240	9 - 11		HR			SIENNA
FELICIO (WAV 168)	af	4	740	70 - 75	13 - 14	2	blunt	8	2	10	55	30	3	3,5	180	90 - 110	160 - 200	9 - 11	IR	HR	IR	IR	FELICIO (WAV 168)
GUSTY	af	6	770	70 - 75	11 - 12	2	blunt	8 - 9	2	7	30	41	20	3,7	190	90 - 110	170 - 210	9 - 11		HR			GUSTY
LAREX	n	6	770	75 - 80	12 - 13	2	blunt	6 - 8	6	17	42	34	1	3,1	165	90 - 110	150 - 180	9 - 11		HR			LAREX
PREFERENCE PLS	af	7	790	70 - 75	12 - 13	2	pointed	9 - 10	2	8	32	44	14	3,6	200	90 - 110	180 - 220	9 - 11		HR	HR		PREFERENCE PLS
MARIMBA	n	7	790	60 - 65	13 - 14	3 - 4	blunt	8 - 9	2	10	55	30	3	3,2	185	90 - 110	170 - 205	9 - 11	IR	HR	IR	IR	MARIMBA
LYRIC	n	8	800	65 - 70	13 - 14	3 - 4	blunt	8 - 10	1	7	54	36	2	3,3	190	90 - 110	175 - 210	9 - 11	IR	HR		IR	LYRIC
ESPRIT	n	8	800	65 - 70	13 - 14	2 - 3	blunt	7 - 9	3	8	36	42	11	3,5	200	80 - 100	170 - 200	8 - 10		HR			ESPRIT
MARQUIS	af	9 - 10	820	65 - 70	13 - 14	3 - 4	blunt	9 - 10	10	25	50	15	0	2.9	160	90 - 100	150 - 170	9 - 10	IR	HR		IR	MARQUIS
BOOGIE	af	10	825	65 - 70	13 - 14	2 - 3	blunt	7 - 9	2	6	30	44	18	3,7	210	80 - 100	170 - 210	8 - 10		HR	HR		BOOGIE
LEGACY PLS	n	10	830	70 - 75	15 - 16	3	blunt	8 - 9	6	10	35	37	13	3,4	200	80 - 100	170 - 200	8 - 10	IR	HR	HR		LEGACY PLS
QUERIDA	n	10	830	65 - 70	15 - 16	3	blunt	9 - 11	2	6	37	50	5	3.5	200	80 - 100	170 - 200	8 - 10	IR	HR	IR	IR	QUERIDA
DANCER	af	11	845	75 - 80	15 - 16	3 - 4	pointed	9 - 11	4	13	51	30	2	3,1	175	90 - 100	150 - 180	9 - 10	IR	HR	IR	IR	DANCER
VIDOR	n	12	850	70 - 75	14 - 15	2 - 3	blunt	8 - 9	1	5	36	38	20	3,6	185	80 - 100	170 - 200	8 - 10	IR	HR	HR		VIDOR
EXPO PLS	n	12	855	70 - 75	14 - 15	3 - 4	blunt	8 - 9	6	21	58	15	0	2,8	140	80 - 100	115 - 140	8 - 10		HR	IR		EXPO PLS
SERGE PLS	af	12	855	75 - 80	15 - 16	2	pointed	9 - 11	5	5	35	35	20	3,6	180	80 - 100	160 - 180	8 - 10	IR	HR	IR		SERGE PLS
DARLIN	af	12	855	70 - 75	15 - 16	3 - 4	pointed	9 - 11	10	25	50	15	0	2,7	160	80 - 100	140 - 170	8 - 10	IR	HR	IR	IR	DARLIN
SILAS (WAV 1394)	n	13 - 14	880	75 - 80	16 - 17	2	pointed	11 - 12	5	20	36	34	5	3,0	175	80 - 100	160 - 180	8 - 10	IR	HR	IR	IR	SILAS (WAV 1394)
KIROS	n	14	890	70 - 75	15 - 16	3	blunt	7 - 9	5	12	40	34	9	3,3	170	80 - 100	140 - 170	8 - 10		HR			KIROS
RAINIER	n	15	905	70 - 75	16 - 17	3	blunt	7 - 8	2	10	36	42	10	3,4	180	80 - 100	150 - 180	8 - 10		HR	IR		RAINIER
PLATON	n	15	910	75 - 80	17 - 19	2 - 3	blunt	8 - 9	0	10	25	45	20	3,7	200	80 - 100	170 - 200	8 - 10	IR	HR	IR	IR	PLATON
BANJO	n	15 - 16	915	65 - 70	17 - 18	3	blunt	7 - 9	5	20	45	25	5	3,0	160	80 - 100	140 - 170	8 - 10	IR	HR	IR	IR	BANJO
BALLADE	af	18	950	75 - 80	18 - 19	3 - 4	pointed	7 - 9	5	20	55	20	0	2,9	160	80 - 100	140 - 170	8 - 10	IR	HR	IR	IR	BALLADE

Portfolio Petit Pois

VARIETY	LEAFTYPE	GROWTH CHARACTERISTICS				POD			% PEA GRADES AT TR 110 - 120					SEED				RESISTANCES				VARIETY
		days to maturity relative to KISS[1]	heat units (°C)	average height cm	nodes to 1st flower	pods per node	shape of pod	peas per pod	I XF < 7,5	II VF 7,5 - 8,25	III F 8,25 - 8,75	IV M 8,75 - 9,25	average grading	weight of 1000 seeds in g appr.	plant stand per m²	seed rate appr. kg/ha	seed rate units/ha	PEMV	Fop 1	Ep	Pv	
NATALIE	n	4	735	65	10 - 11	2 - 3	blunt	6 - 10	25	55	20		1,95	105	90 - 110	85 - 115	9 - 11		HR		IR	**NATALIE**
ELOISE	af	6	765	70	12 - 13	2 - 3	pointed	9 - 10	40	50	10		1,7	100	90 - 110	90 - 110	9 - 11	IR	HR		IR	**ELOISE**
NOELLE	n	9	830	70 - 75	13 - 14	3	pointed	10 - 11	30	55	15		1,85	100	90 - 100	90 - 100	9 - 10	IR	IR	IR	IR	**NOELLE**
WAVEREX	n	10	830	60 - 65	14 - 15	2	blunt	8	29	36	20	15	2,2	110	90 - 100	100 - 110	9 - 10					**WAVEREX**
MADELINE	n	10	825	75	14 - 15	3	pointed	10 - 11	40	50	10		1,7	90	80 - 100	75 - 90	8 - 10	IR	IR	IR	IR	**MADELINE**
SATURINO (WAV 4073)	n	11	840	70 - 75	14 - 15	2 - 3	pointed	9 - 10	49	41	10		1,6	90	90 - 100	90 - 100	9 - 10	IR	HR	HR	IR	**SATURINO (WAV 4073)**
ZARA	af	16	915	85 - 90	15 - 16	3	pointed	8	30	55	15		1.85	100	80 - 100	75 - 90	8 - 10	IR	HR	IR	IR	**ZARA**

[1] KISS maturity 0 days = 675 heat units

The information shown in the above list is based on crops grown under normal conditions in central Europe. Allowances have to be made for other climates and growing conditions. Any recommendations for use of VAN WAVEREN's products or material or apparatus in connection therewith are based on VAN WAVEREN's best judgement, but there is no warranty of results to be obtained in connection therewith.

Leaftype

af afila, reduced leaves
n normal leaves

Resistances

PEMV Pea Enation Mosaic Virus
Fop 1 Fusarium oxysporum f. sp. pisi race1 (Fusarium wilt)
Ep Erysiphe pisi (Oidium, Powdery mildew)
Pv Peronospora viciae = Downy Mildew

Definition according to ISF rules (International Seed Federation)

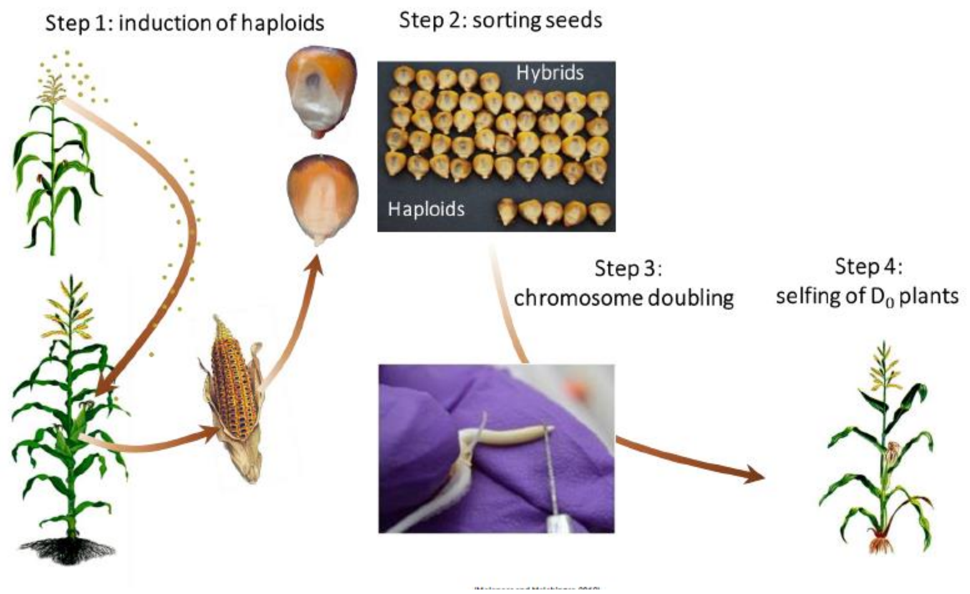
IR intermediate / moderate resistance
HR high / standard resistance

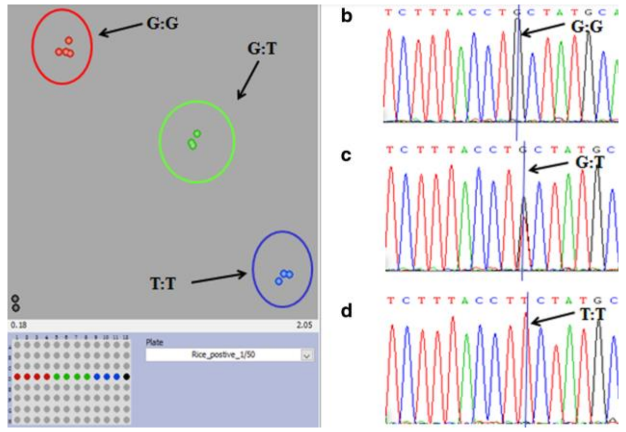
Portfolio Fresh Market

VARIETY	LEAFTYPE	MATURITY	HEAT	PLANT	NODES	POD				FRESH SEED	SIEVE	SEED				RESISTANCES			VARIETY
			units	height in cm	to first blossom	pods per node	average pod length approx. in cm	shape	seed per pod	colour	size	weight of 1000 seeds in g	plant per m²	seed rate appr. kg/ha	seed rate units/ha	PEMV	Ep	Fop 1	
FINOMINA	n	early	725	65	9 - 10	1 - 2	9 - 11	pointed	8	darkgreen	large	270	80 - 90	215 - 250	8 - 9				**FINOMINA**
GRANDERA	af	medium early	770	70 - 75	11 - 12	2	10 - 10,5	pointed	8 - 10	darkgreen	large	appr. 300	80 - 100	250 - 300	8 - 10			HR	**GRANDERA**
BUDDY	n	medium early	790	70 - 75	13 - 14	2	9,5	blunt	8	darkgreen	large	appr. 300	80 - 90	270 - 300	8 - 9			HR	**BUDDY**
EDDY	n	medium late	850	75 - 80	15 - 16	2	11 - 12	pointed	9 - 11	darkgreen	large	appr. 260	80 - 90	230 - 250	8 - 9		IR		**EDDY**
AMBASSADOR	n	medium late	855	75 - 80	15 - 16	2	7,5 - 8	blunt	8 - 9	darkgreen	medium	appr. 200	80 - 90	170 - 200	8 - 9	IR	IR	HR	**AMBASSADOR**

hybrid breeding

P1 x P2





selection

Testcrosses

selection

Hybrid selection & Application for registration

- Multilocational yield trials
- **Hybrid screening**
- Hybrid release


Hybrid Sweet Corn (sh2)
WIM

KERNEL COLOR	Yellow
MATURITY (DAYS)	80
PLANT HEIGHT	240 cm
EAR HEIGHT	110 cm
NUMBER OF KERNEL ROWS	16 - 18
EAR LENGTH	22 - 23 cm
EAR DIAMETER	4,7 – 4,8 cm
EAR SHAPE	Cylindrical
HUSK PROTECTION	Medium husk coverage
SNAP	Medium snap
SHANK	Medium length
TIP FILL	Well filled

- Haploid induction & DH line development
- Marker assisted selection
- DH line per se evaluation
- DH Selection/multiplication
- Crosses with testers

- Multi-locations
- Test for general combining ability (GCA)
- Test for specific combining ability (SCA)
- **Genomic prediction of hybrids?**

Nota bene: for hybrid breeding **parental (DH) lines are developed** and crossed and **the F1 is sold as a product**!