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Training in organic breeding

Module 2: Phenomics: approaches and tools for genetic resources and breeding material characterization

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

Author: Pedro Mendes Moreira **(PUC-ESAC, PT)**

CONTEXT: Training in LIVESEEDING project

https://liveseeding.eu/trainings-summer-school/

Training in organic breeding organized in 5 Modules

1. **Module 1** - Plant Genetic Resources (PGRs): collection, conservation and exchange to support the increase of agrobiodiversity in farming systems

2. **Module 2 - Phenomics: approaches and tools for genetic resources and breeding material characterisation - FEBRUARY 3rd 2025, 9:00 to 17:30 CET**

3. **Module 3** - Breeding methods fundamentals - FEBRUARY 13th 2025, 9:00 to 18:00 CET

4. **Module 4** - Development and application of molecular methods in organic breeding - MARCH 4th 2025, 9:00 to 18:00 CET

5. **Module 5** - Organic heterogeneous material (OHM) design and development - MARCH 7th 2025, 9:00 to 18:00 CET

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Module 2 – Phenomics: approaches and tools for genetic resources and breeding material characterisation

February 3rd 2025 - 9:00 to 17:30 CET

Unit 2.1: Main descriptors used worldwide in characterizing plant genetic resources
- 9:00-10:30 - UPV (Adrian Rodríguez-Burruezo)

- 10:30-11:00 Break

Unit 2.2: Intro to ShineMas: a web tool dedicated to Seed Lots History, Phenotyping and Cultural Practices[1]
- 11:00-12:30 - INRAe (Yannick de Oliveira, Isabelle Goldringer)

- 12:30-14:00 Lunch Break

Unit 2.3: Guidelines and examples of good practices in data management
- 14:00-15:30 - INRAe (Yannick de Oliveira, Isabelle Goldringer)

- 15:30-16:00 Break

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming
- 16:00-17:30 - IPC (Pedro Mendes Moreira)

Unit 2.5: Methods for phenotyping and selection of added-value traits (e.g. taste and nutritional value)[2]
ITAB (Solenne Jourdren)

1 - An extra practical session to use the tool with own data is scheduled for FEB 10th (9-12h)
2 - Unit 2.5 planned for the end of March 2025. Registrants will be invited for this extra training lesson

T1.4 Training in Organic Breeding

Module 2 – Phenomics: approaches and tools for genetic resources and breeding material characterization

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

Pedro Mendes-Moreira

Polytechnic University of Coimbra

Agriculture School of Coimbra

Module 2 – Phenomics: approaches and tools for genetic resources and breeding material characterization

Planned for today

DYNAMIC MIXTURE OF:

1. *Presentation about main topics on* Methods for **phenotyping** and selection of **agronomic traits** of interest in organic farming*: utility, types, examples of descriptors, management of data, knowledge, additional material (50 min)*

2. Fast quiz (about 10 min) ***

3. Debate, Wrap up & Proposed homework (about 10-15 min) ***

4. QUESTIONS: THROUGH THE CHAT (Petra Jelincic will manage)

*** = IMPORTANT for CERTIFICATES (ALL THE UNITS!!!!)

LiveSeeding   SEND TO BOTH: adrodbur@doctor.upv.es   petra.jelincic@ips-konzalting.hr

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Module 2 – Phenomics: approaches and tools for genetic resources and breeding material characterization

Where are the plant traits?

In U2.1 you have already contacted with the descriptors from BIOVERSITY, however... **Do all the traits have the same importance?... Never forget the phenology!**

Why we do not take all the data, described in the descriptors during all phases of a plant breeding program? More traits measured are needed for registration phase.

P= G + E + S + G x E x S...

Traits(n) x Plants/Plot x Plot x Locations x Managing Systems

Cost to measure

How can we be more effective with our resources?

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

Unit 2.4: Methods for **phenotyping** and selection of **agronomic traits** of interest in organic farming

What is phenotyping?

Plant phenotyping, the quantitative description of plant traits, is crucial for plant breeding and precision agriculture. It involves characterizing anatomical, physiological, and biochemical properties of plants (Walter et al., 2015)

What are Agronomic traits?

Agronomic traits are key targets for crop improvement, encompassing yield, quality, and stress resistance (Zhang et al., 2021)... And what about Organic...

But why we care about Agronomic Traits for Organic?
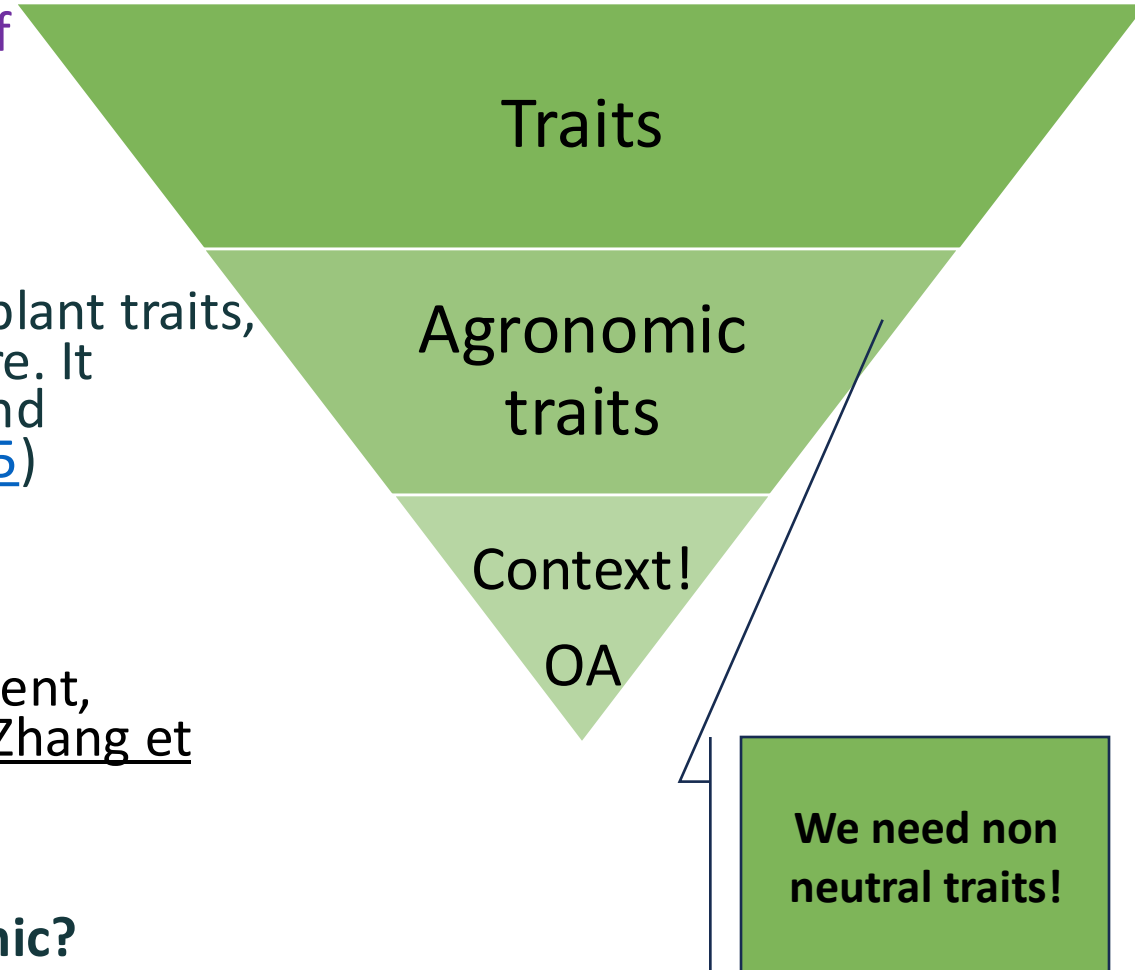
Traits

Agronomic traits

Context!

OA

We need non neutral traits!

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But why we care about Agronomic Traits for Organic?

Conventional varieties often **lack traits essential for organic production**!

Traditional breeding in high-input environments has led to:

- traits with negative **side-effects** in organic settings, like reduced disease resistance and lower nutrient-use efficiency ([Bueren et al., 2011](#)).

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But why we care about Agronomic Traits for Organic?

Conventional varieties often lack traits essential for organic production!

- **Nutrient use efficiency from organic inputs,**

- **Weed competitiveness** (improving crop performance in organic systems and contributes to sustainable agriculture

- **Pest and disease resistance** (Bueren et al., 2011; Rempelos et al., 2023).

But why we care about Agronomic Traits for Organic?

Conventional varieties often lack traits essential for organic production!

- **nutrient use efficiency from organic inputs**,
  - o Can enhance soil health, microbial biomass, and carbon content, potentially improving NUE over time (Toda et al., 2023).
  - o A function of improved cultivars, best management practices, soil health factors (Baligar et al., 2001).

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

But why we care about Agronomic Traits for Organic?

Conventional varieties often lack traits essential for organic production!

- **weed competitiveness** (improving crop performance in organic systems and contributes to sustainable agriculture practices),
    - key traits for cereals, include plant height, early vigor, tillering capacity, and early maturity (Mason et al., 2007)
    - heterozygosity levels in faba beans (Ghaouti et al., 2016)
    - For soybeans, a direct selection system using crop species mixtures as competitors has been developed to screen for weed-tolerant genotypes (Horneburg et al., 2017).
    - adaptation to specific environments, and PPB (Wolfe et al., 2008)
    - enhanced crop competitiveness on organic maize to sustain yield (Ryan et al., 2009).

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But why we care about Agronomic Traits for Organic?

Conventional varieties often lack traits essential for organic production!

- **pest and disease resistance** (Bueren et al., 2011; Rempelos et al., 2023).
    - o Organic management practices can enhance natural pest control by altering plant resistance to insects, mediated by rhizosphere microbial communities and salicylic acid accumulation (Blundell et al., 2020).
    - o Arbuscular mycorrhizal fungi can induce plant disease resistance, suggesting their importance in organic plant breeding (Hohmann and Messmer, 2027) .

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But why we care about Agronomic Traits for Organic?

- Organic breeding programs should focus on traits prioritized by farmers, processors, and consumers ([Rempelos et al., 2023](#)).

The correspondence between descriptors by BIOVERSITY and Breeders indicate a GAP!

Knowing that fact ECPGR EVA programs are trying to fill that GAP

In 2011 an attempt was made to indicate some important traits

Solibam

Strategies for Organic and Low-input integrated Breeding and Management

Grant agreement number: FP7- KBBE-245058

Collaborative project (Large-scale integrating project)

SEVENTH FRAMEWORK PROGRAMME

Deliverable 1.5
Determination of traits most relevant for model species of cereals, grain legumes and vegetables

Due date: M12

Actual submission date: March, 11th 2011

Project start date: March 1st, 2010   **Duration:** 54 months

Workpackage concerned: 1

Concerned workpackage leader: Véronique CHABLE

Dissemination level: PU

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3 – Traits of Maize (*Zea mays* L.)

List of characters to be scored, from Pedro Mendes-Moreira:
Characterisation to be carried out according to a randomized block design with replications.
Data preferably to be collected on single plant basis (10-20 plants per genotype per each replicate) or per plot.

Traits	Prescritive		Codes		Description
	Plot	Pl/Ears			
Days-to-silk, nº †	1*		Fi	days	The beginning of days to silk (from planting until 50% of the plants in the plot begin silk emergence.
Days-to-silk, nº † end	1*		Ff	days	The end of days-to silk (from planting until 50% of the plants in the plot begin and finish silk emergence.
Days-to-anthesis, nº †	1*		Mi	days	The beginning of days-to anthesis, i.e., from planting until 50% of the plants in the plot begin anthesis
Days-to-anthesis, nº † end	1*		Mf	days	The end of days-to anthesis (from planting until 50% of the plants in the plot end silk emergence
Height	1		Ĥ	cm	Average plant height, from the stalk basis to the last leaf insertion before the tassel
Uniformity	1		U	score	1 - minimum uniformity and 9 - maximum; 1-5 to populations and 6-9 to inbreds.
aNgle-leaf	1		N	score	Angle of the adaxial side of the leaf above the ear with the stalk (5=45º, <5 =<45º and >5 = >5=45ºC)
Tassel	1		T	score	Tassel branching. 1- absent tassel (Inbreeds and hybrids) 9- a much branched tassel (frequent in populations with abnormal fasciated ears).
Ear placement	1		E	score	5- indicates that the ear is located in the middle of the plant.
Root lodging %	1		R	%	Percentage of plants leaning more than 30º from vertical
Stalk lodging %	1		S	%	Percentage of plants broken at or below the primary ear node, related with the quality of the stalk and the stalk damage caused by some insect attack.
Yield	1		Yield	Mg ha^{-1}	Grain yield (Mg ha-1) 15% moisture, a1) hand harvest (Portugal), Grain yield = Ear weight x (Grain weight/Ear weight) five shelled ears are used for determination of this racio and for moisture content

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- What do we search for our program?

- What is our context?

VASO 1.0 - Genesis reasons in 1984

To solve the problems of small Portuguese farmers with limited land, dense population, and an inadequate productivist model, where big corporations have little interest in this market.

To respect local culture promoting the selection and breeding of genetic resources increasing the yield, maintaining the quality.
To keep germplasm evolving with time!

The Majority of the germplasm that I work with is used for human consumption

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Traditional Foods From Maize (*Zea mays* L.) in Europe

Pedro Revilla[1*]   Mara Lisa Alves[2]   Violeta Andelković[3]   Carlotta Balconi[4]

Isabel Dinis[5]   Pedro Mendes-Moreira[5]   Rita Redaelli[4]   Jose Ignacio Ruiz de Galarreta[6]

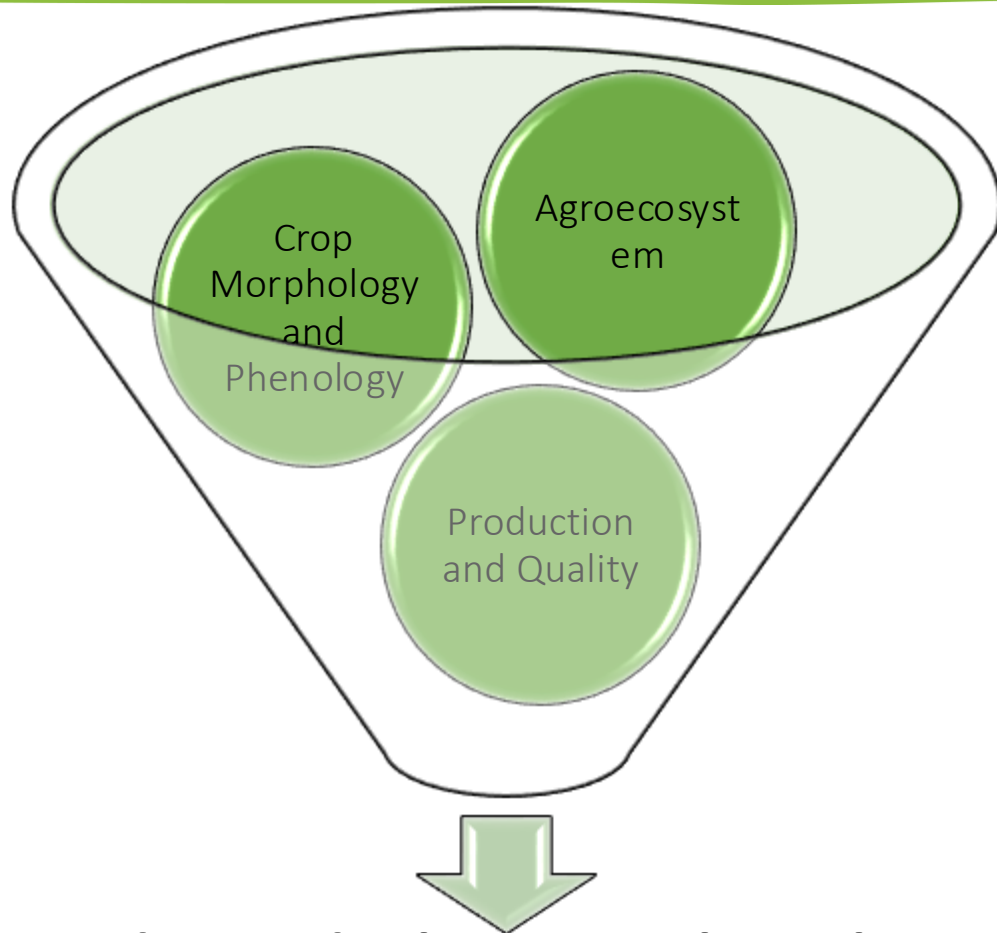Maria Carlota Vaz Patto[2]   Sladana Žilić[7]   Rosa Ana Malvar[1]

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

Crop Morphology and Phenology

Agroecosystem

Production and Quality

Breeders and other actors best choices
(This ilustrate part of the GAP information needed by breeders

Yield maintaining quality?

Desirable stand?

Pest and diseases?
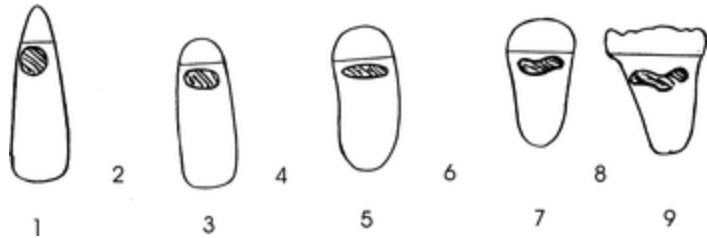
Can we know more about our populations flowering behavior?
...

Neutral marker

What germplasm are you working in?

Do you have fasciation?

If your germplasm do not have fasciation your result will be always "1" so it is a neutral marker. But for us! You need to know what are your matherials and what you want from them! Case they have

Broad diversity? Prebreeding Work

The HUNTERS (**H**ight, **U**niformity, a**N**gle, **T**assel, **E**ar, **R**oot lodging and **S**talk lodging) analysis was developed as a method of evaluation

1–9 scale (1: very low, 2: very low to low, 3: low, 4: low to intermedium, 5: intermedium, 6: intermedium to high, 7: high, 8: high to very high and 9: very high) defining an average value per plot (Vaz Patto et al., 2007; Mendes Moreira et al., 2008)

H: Plant high (m) from the stalk basis to the last leaf insertion before the tassel.

U: Uniformity, complementary to diversity, where 1 is the minimum of uniformity and 9 the maximum. In general 1–4 applies to populations and 5–9 to inbreeds.

N: Angle of the adaxial side of the leaf above the ear with the stalk. <5 - angles inferior to 45º and >5, angles higher than 45 . Five = 45 angle.

T: Tassel branching. One - almost absent tassel common in inbreeds and hybrids, and 9 a very branched tassel, frequent in populations with abnormal fasciated ears.

E: Ear location. Five indicates that the ear is located in the middle of the plant.

R: Root lodging. It indicates the percentage of lodged plants and is related with the quality of the root system.

S: Stalk lodging. Percentage of broken plants. Is normally related with the quality of the stalk and the stalk damage caused by some insect attack.

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Yes! We can easily connect
this traits with SEEEDLINKED

Unit 2.4

(A) - Immediately **before the pollen shedding**, detasseling all the undesirable plants (pest and disease susceptible, weakest and plants that do not fit the desirable ideotype);

(B) - **Before harvest**, besides selecting for the best ear size, the plants are foot kicked at their base (first visible internodes) to evaluate their root and stalk quality. Indirect measurement evaluation for pest and disease tolerance. If the plant breaks, it is eliminated. select prolific plants;

(C) - **At the storage** facilities, after harvest, selection is performed (normal and prolific ears) for ear length, kernel-row number, prolificacy, and the elimination of damaged/diseased ears. The selected ears are shelled and mixed together to form the next generation seed. The farmer selection pressure ranged from 1 to 5%

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A. Antes da floração
Olhe para as plantas! - **Desbandeira as "doentes e anormais"**

B. À colheita (ou uma semana antes)
1° **Produção** - Olhe para a espiga!
  a) **Tamanho**
  b) **Mais que uma?** (Prolífica)

2° **Sanidade** - Olhe para as folhas e cale e...pontapé!
  a) **Doenças** (fungos)
  b) **Pragas** (insetos)
  c) **Raíz**

3° **Arquitetura** - Olhe para as plantas
  a) **Altura**
  b) **Inserção da espiga**
  c) **Encamisamento**
  d) **Ângulo das folhas**

use dois sacos: — normais
— prolíficas

C. No espigueiro (Armazém)
Olhe para a espiga!
1° **Comprimento**
2° **Carreiras de grão**
3° **Sanidade** - (observa as bases do carolo!)
4° **Determinada vs indeterminada**

5° **Elimine os dois extremos**

Figura 3. Esquema de duas seleções de controle parental no campo, Fase A e B ao que se segue a Fase C no espigueiro ou armazém.
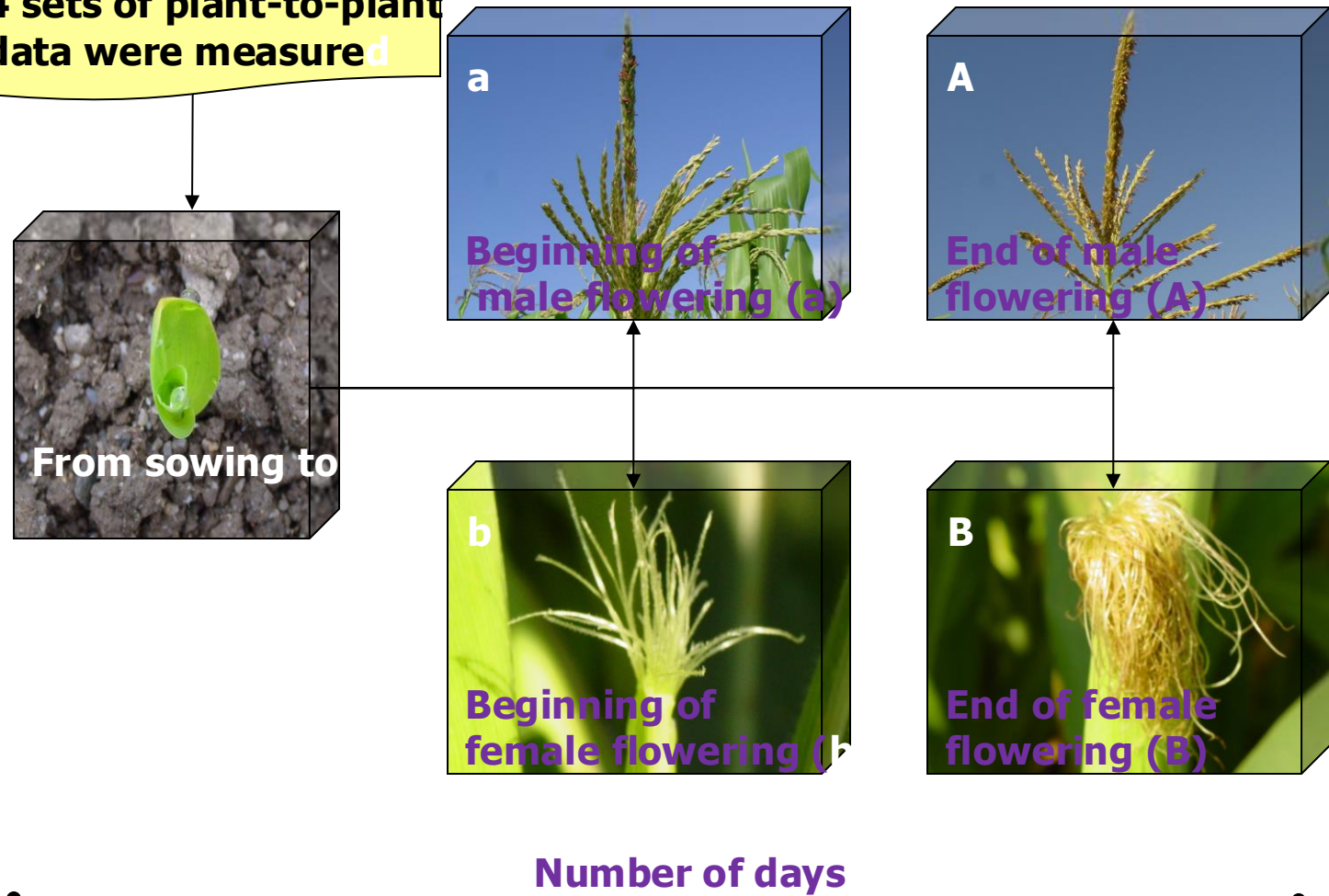
826 plants – VA Lousada

4 sets of plant-to-plant data were measured

The theoretical reasoning employed consists in **assuming** that all the **polinization occures only under gravity influence**, so that when maize plant has the hypothesis of flowering overlapping, this selfing probability will have a direct effect on the inbreeding depression.

This method enables the knowledge of a population concerning the relative amount of theoretical allogamy versus autogamy.

From sowing to

a Beginning of male flowering (a)

A End of male flowering (A)

b Beginning of female flowering (b)

B End of female flowering (B)

Number of days

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$$OI = \frac{(B-b)+(A-a)-|B-A|-|b-a|}{2(B-b)}$$

The number of days from planting, to the beginning (a) or end (A) of male flowering; or to the beginning (b) or end (B) of female flowering.

Evaluation of the overlapping index (OI) conditions:
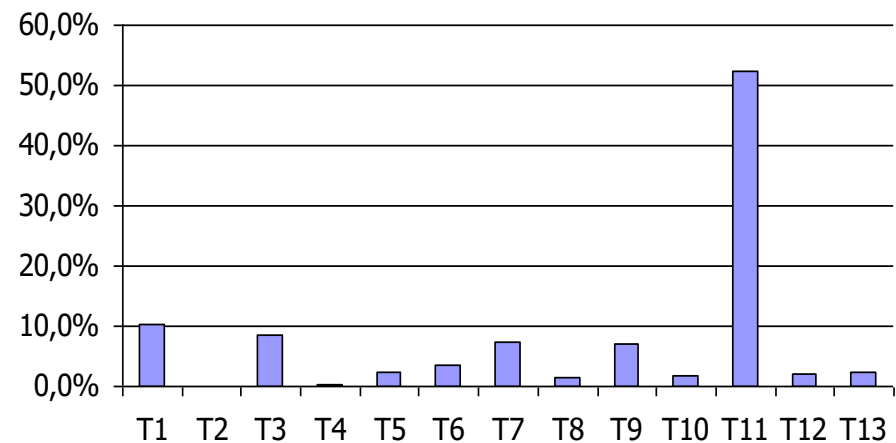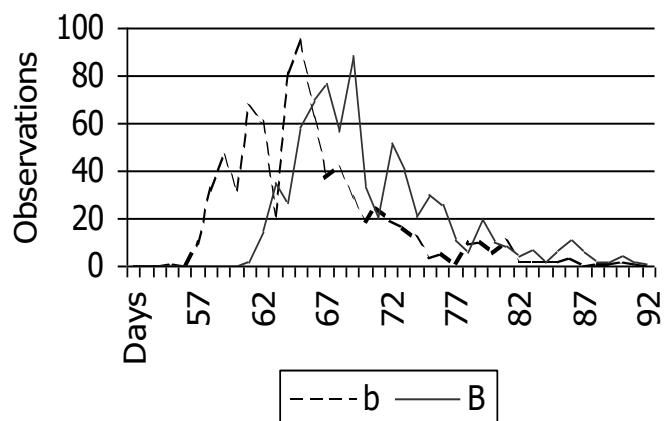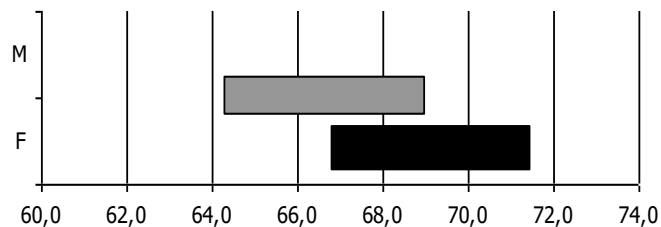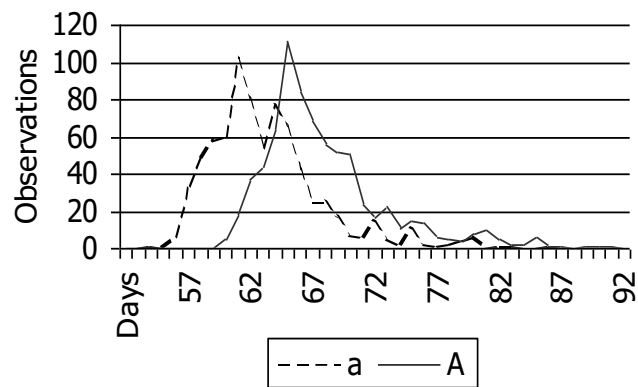
OI is limited to 1 (100 %)

OI is either positive (some overlapping) or negative (overlapping does not occur).

Maize breeders always look for high functional allogamy, so the selection for negative values of OI is pursued.

The proposed evaluation method can be conducted in only one year time, based on 13 possible overlapping types (T1-T13) (Figure 1).
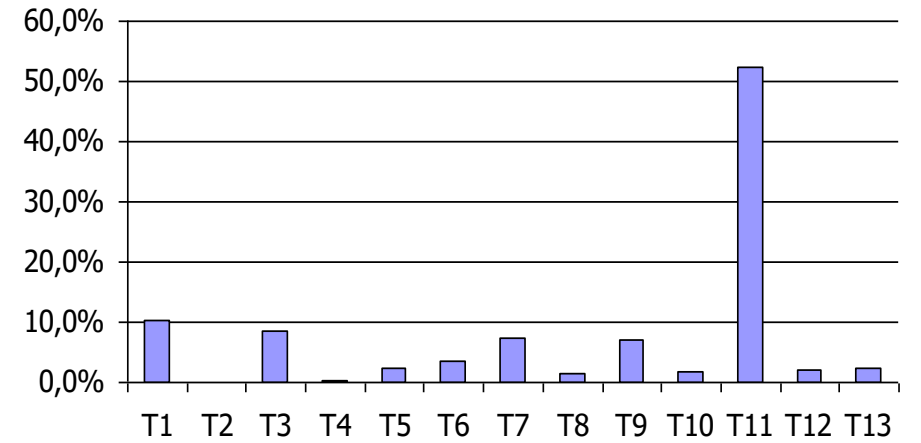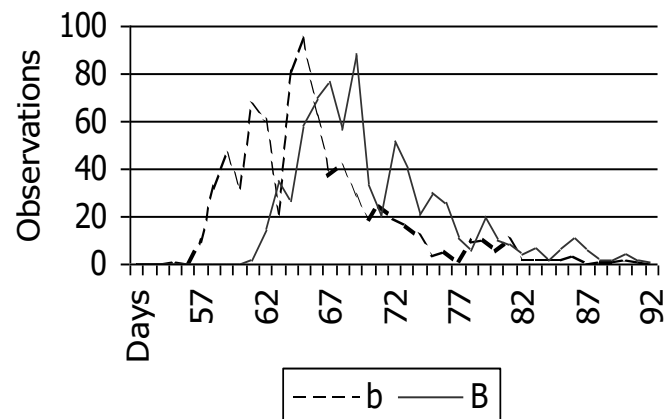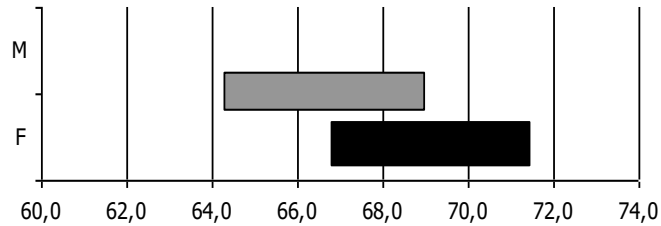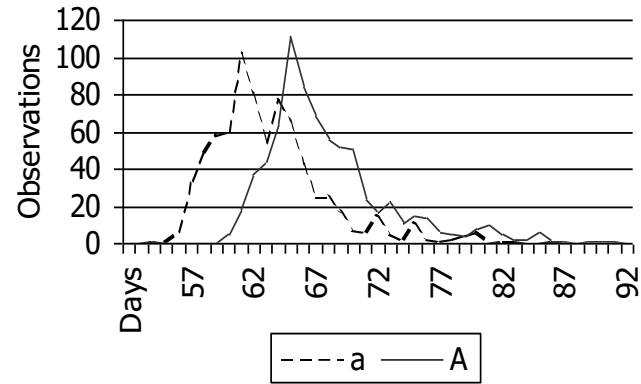
Moreira, P. M., & Pêgo, S. (2003)

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OI	Obs.	%
OI<0		
T1	76	10,33
T2	1	0,14
OI=0		
T3	62	8,42
T4	2	0,27
OI=1		
T5	17	2,31
T6	27	3,67
T7	55	7,47
T8	11	1,49
0<OI<1		
T9	53	7,20
T10	14	1,90
T11	385	52,31
T12	16	2,17
T13	17	2,31
Total	736	100

- Verdial de Aperrela:
  - ~19 % of no overlapping (OI <= 0, complete allogamy); ~15 % of complete overlapping (OI = 1, possible selfings all along the ear); ~66 % of partial overlapping (0 < OI < 1, possible selfings in specific parts of the ear).
- The population is represented in more than 50 % of the cases by partial overlapping of the type T11 (52.3 %). Even in this case (T11), our results show that 46.3 % of the kernels could have been selfed, while 53.7 % are hybrids.

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| OI		Obs.	%
OI<0	a A		
T1	b B	76	10,33
	a A		
T2	b B	1	0,14
OI=0	a A		
T3	b B	62	8,42
	a A		
T4	b B	2	0,27
OI=1	a A		
T5	b B	17	2,31
	a A		
T6	b B	27	3,67
	a A		
T7	b B	55	7,47
	a A		
T8	b B	11	1,49
0<OI<1	a A		
T9	b B	53	7,20
	a A		
T10	b B	14	1,90
	a A		
T11	b B	385	52,31
	a A		
T12	b B	16	2,17
	a A		
T13	b B	17	2,31
Total		736	100

- An unexpected amount of complete allogamy (OI = 19.16 %) constitutes a selection potential for increasing allogamy at the expenses of possible autogamy.
- Figures 4 and 5 present some **differentiated peak**s, showing that this **population is not well recombined** and suggest it to be composed by at least three sub-populations which almost do not overlap. This represents a potential for both recombination and further genetic diversity implementation.

Trials – What environments to use
G + E + S + GxExS
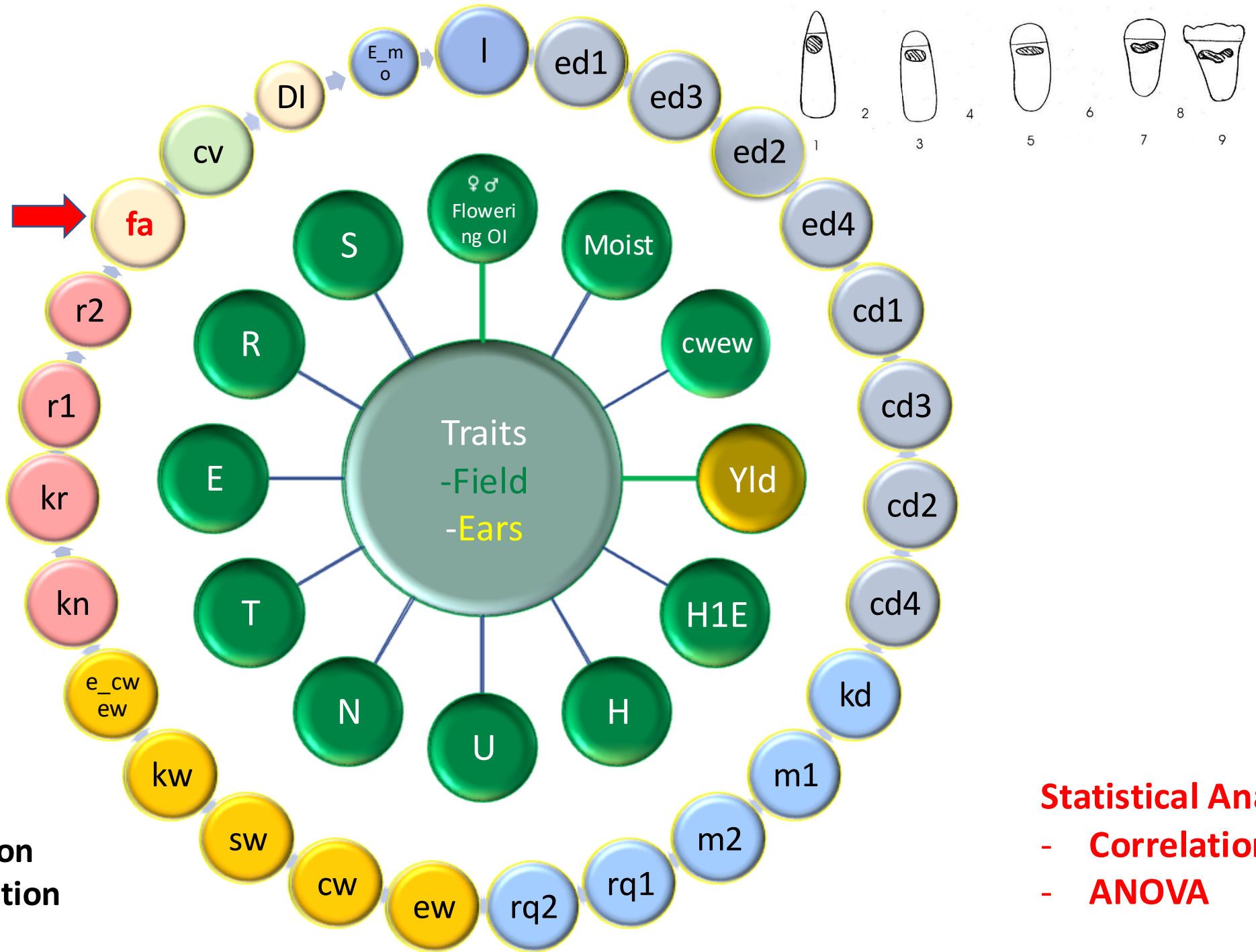
Traits used for population characterization

Statistical Analyses
- Correlations
- ANOVA

Example 2
Trial in Organic and Conventional

Rank Cal	Organic - Caldeirão		Rank V	Conventional - Vagem		Rank diferences
1	VA C0S0 19 - (Regadio Lousada	4313,74	19	VA C0S0 19 - (Regadio Lousada	6450,77	18
2	2501 - (11-2019 Caldeirão 2019	4252,3	21	2501 - (11-2019 Caldeirão 2019	6344,97	19
3	Bulk-Azores 2 - (110-2019 Cald	4248,98	11	Bulk-Azores 2 - (110-2019 Cald	7308,47	8
4	2516 - (23-2019 Caldeirão 2019	4235,95	30	2516 - (23-2019 Caldeirão 2019	5675,8	26
5	2527 - (Caldeirão 2018)	4195,12	35	2527 - (Caldeirão 2018)	5575,57	30
6	2499 - (9-2019 Caldeirão 2019)	4127,95	5	2499 - (9-2019 Caldeirão 2019)	7961,27	-1

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

What are the resources that you have?

Selecting for drought tolerance/resistance based on yield is a complicated task due to the complex nature of the trait and its low heritability . The task becomes particularly complex for participatory breeding approaches in which selection tools are to be applied directly by farmers.

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Maize Open-Pollinated Populations Physiological Improvement: Validating Tools for Drought Response Participatory Selection
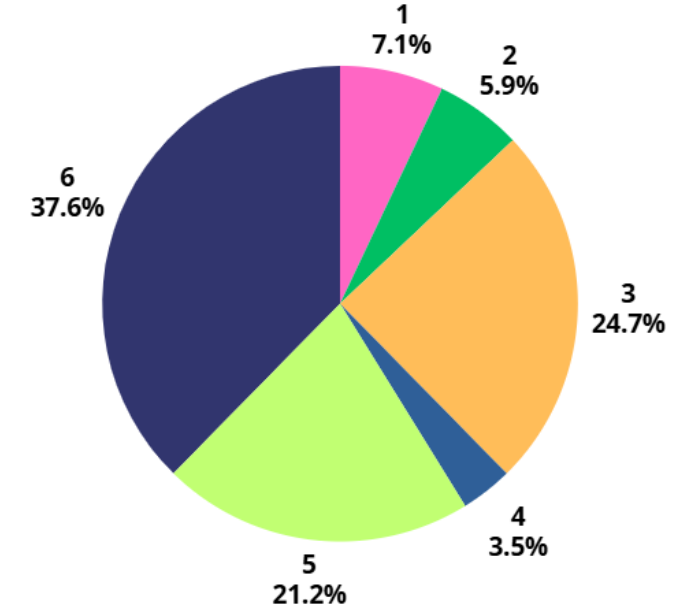
by Susana T. Leitão [1], Emanuel Ferreira [2], M. Catarina Bicho [1,3], Mara L. Alves [1], Duarte Pintado [2], Daniela Santos [2], Pedro Mendes-Moreira [2], Susana S. Araújo [1], J. Miguel Costa [4] and Maria Carlota Vaz Patto [1,*]

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Evaluation

https://www.facebook.com/ESAC.IPC/videos/420973937771190

Mister Tomate

Resultados da Escola da Agrária

Do we have the same results?
https://www.facebook.com/ESAC.IPC/videos/420973937771190

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Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

PPB – from the farmer to the statistical tools - MARS, RF, CART

Is ear value an effective indicator for maize yield evaluation?

Pedro M.R. Mendes-Moreira [a] [h] [i], João Mendes-Moreira [b] [c], António Fernandes [d], Eugénio Andrade [e], Arnel R. Hallauer [f], Silas E. Pêgo [g] [i], M.C. Vaz Patto [h] [i]

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Highlights

- A set of maize traits that could help farmers on selection for yield was identified.

- A new ear value formula that better estimates the yield potential was obtained.

- A new instance ranking measure to be used for evaluating ear ranks is proposed.

- A new method to be used in participatory research and pre-breeding is proposed.

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(EV formula) was defined as:

$$EV = \frac{0.6 \times KW + 0.2 \times L + 0.15 \times R + 0.05 \times KN}{4} \quad (1)$$

KW stands for kernel weight (grams) at 15% moisture, *L* for ear length (centimeters), *R* for kernel row number and *KN* for total number of kernels.

Not forgetting to feed local iniciatives that can help on PPB recognition

"Best Ear of Sousa Valley competition" can provide adequate measurements, indicate best traits for selection and prediction

E as espigas vencedoras, nas diversas modalidades, aguardam a recompensa para os seus donos...

$$EVA = mlr.varsEV = -7.030877 + 0.031605 \times KW + 0.387825$$
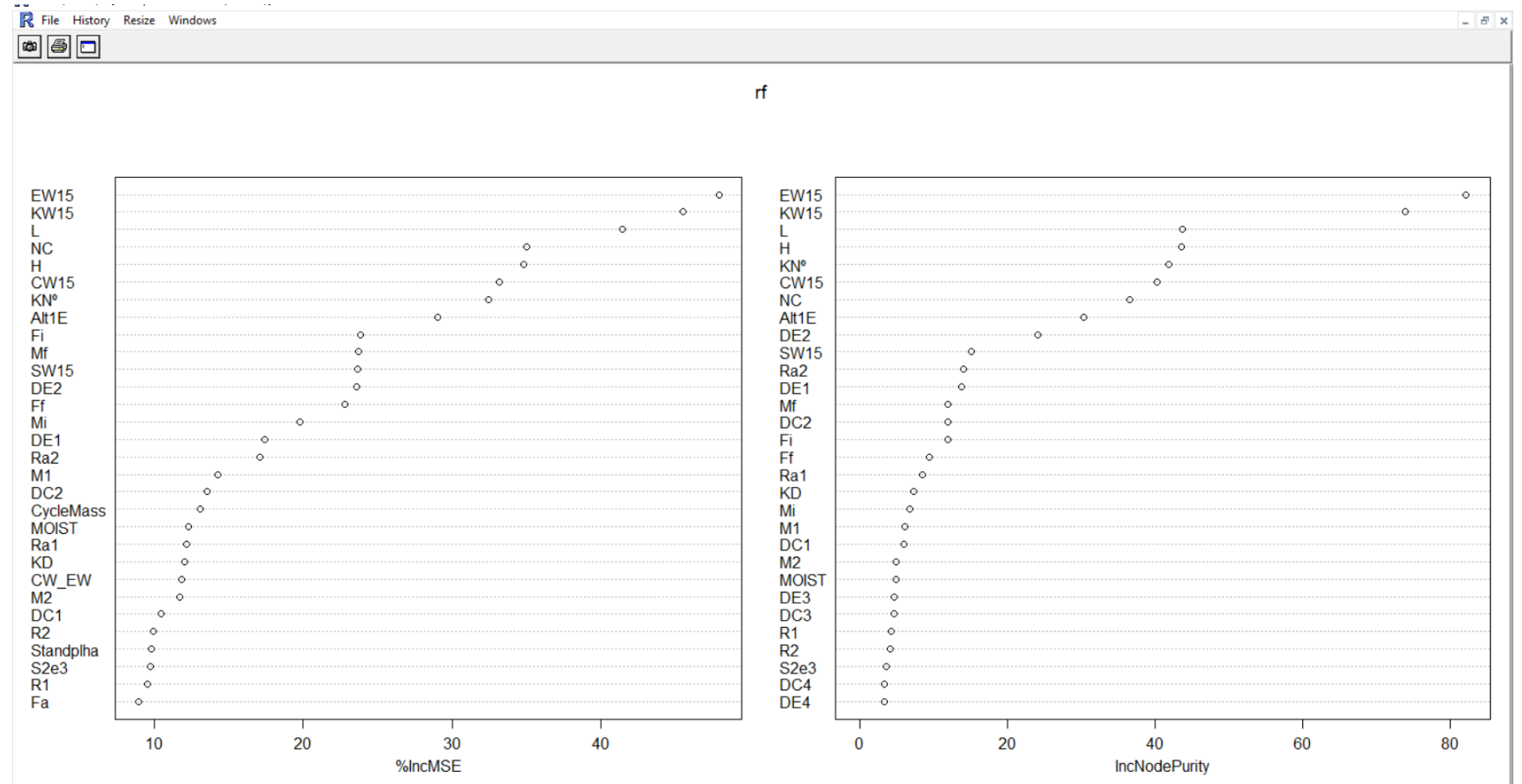$$\times L + 0.337015 \times R12 - 0.008875 \times KN \quad (13 \text{ and } 14)$$

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Table 1

Maize populations' characterization: kernel type, number of instances per population, origin and references.

Population	Kernel type	Data[a]	Origin	Area/plot, ears/plot	References
Nutica	Yellow dent	18	Synthetic Pt (80% USA germplasm)	9.6 m^2; 20 ears/plot	Moreira (2006)
Fandango	Yellow dent	157	Synthetic Pt (80% USA germplasm)	9.6 m^2; 20 ears/plot	Mendes-Moreira et al. (2009)
Pigarro	White flint	305	Populations, Pt	9.6 m^2; 20 ears/plot	Mendes-Moreira et al. (2008)

[a] The number of instances per population corresponds to the product of selection cycles (for 'Pigarro' and 'Fandango'), years, locations with three reps, with exclusion of instances that not have the complete set of traits.
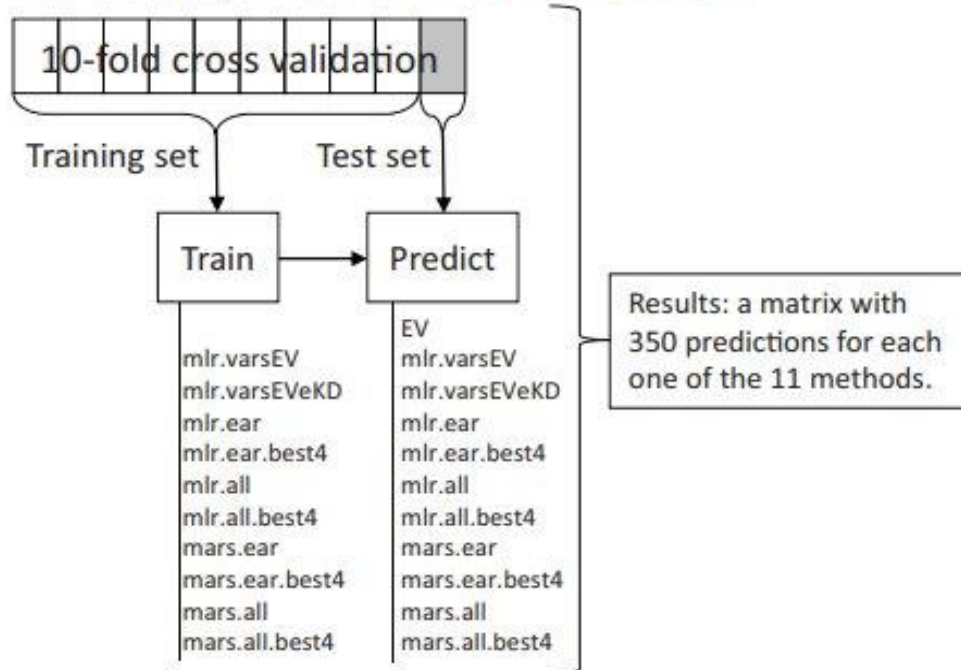
Searching for tools to help on the selection

First step: **YIELD PREDICTION**

10-fold cross validation

Training set | Test set

Train → Predict

	EV
mlr.varsEV	mlr.varsEV
mlr.varsEVeKD	mlr.varsEVeKD
mlr.ear	mlr.ear
mlr.ear.best4	mlr.ear.best4
mlr.all	mlr.all
mlr.all.best4	mlr.all.best4
mars.ear	mars.ear
mars.ear.best4	mars.ear.best4
mars.all	mars.all
mars.all.best4	mars.all.best4

Results: a matrix with 350 predictions for each one of the 11 methods.

$$EV = \frac{0.6 \times KW + 0.2 \times L + 0.15 \times R + 0.05 \times KN}{4} \qquad (1)$$

Second step: **EARS RANKING**

Ranking evaluation using the PRNDCG measure for each one of the 14 groups. ← Random split of the 350 instance columns of the yield prediction matrix into 14 random groups (each group with 25 columns).
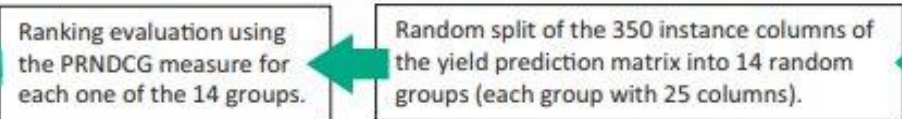
Third step: **STATISTICAL VALIDATION**

Averaging the ranks obtained in the 14 groups per each of the 11 predictors.

Fourth step: **FINAL FORMULA**

$$EVA = mlr.varsEV = -7.030877 + 0.031605 \times KW + 0.387825$$
$$\times L + 0.337015 \times R12 - 0.008875 \times KN \quad (13 \text{ and } 14)$$

Generating a new formula with all the 350 instances using the best interpretable regression method according to the PRNDCG measure..

Agronomic traits of interest in organic. Why?

- ❑*LIMITATION: there are many descriptors, but better to work with those which best encompass the diversity present on a crop and its relatives (comprehensive & discriminating ability)*

- ❑*Characterization with the many descriptors of a crop variety is not enough, search for the traits that respond to agronomic questions, search for better correlations with complex traits such as yield*

- ❑*Essential to better fit the varieties to organic environment (NUE, Weed competitiveness, pest and disease resistance) and focus on traits prioritized by farmers, processors, and consumers (Rempelos et al., 2023).*

- ❑*Check the level of diversity you have*

- ❑*Comparison to other and same accessions in other locations and actors (E + S and GXEXS)*

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

PRACTICAL EXERCISES:

1. Guided visit to Overlap Index Maize

   + example with excel compiled data

1. Guided visit to Maize results

   + example of PUC-ESAC results with own data

SAME, but short, with seedlinked page?

Seedlinked Trials Results

Maize trial_Ensaio Milho: https://app.seedlinked.com/trial/analytics/guest/MjA0Nw==

Tomato degustation trial_Ensaio Tomate degustação: https://app.seedlinked.com/trial/analytics/guest/MjYxMg==

LiveSeeding

Unit 2.4: Methods for phenotyping and selection of agronomic traits of interest in organic farming

DEBATE

❑ *Revise the quiz in common*

❑ *Own previous experiences*

❑ *Other questions and doubts*

WRAP UP

- ❑ *What we have learned today?*
- ❑ *Proposed homework: study case, consider a crop that you are working and identify the five top traits that you would use in a breeding programe*

Send to :
pmm@esac.pt   and   petra.jelincic@ips-konzalting.hr
By next Monday 10th february

LiveSeeding

Escola Superior Agrária
Politécnico de Coimbra

Additional available materials

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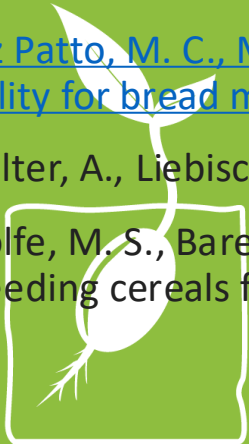
Further readings

Setting Up Decision-Making Tools toward a Quality-Oriented Participatory Maize Breeding Program

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Query Unit 2.4 - Methods for phenotyping and selection of agronomic traits of interest in organic farming

Tomato Evaluation - Choose your perfect tomato acording the shape and collourhttps://www.facebook.com/ESAC.IPC/videos/420973937771190

R: This question allowed to indicate that according to the group we can have different responses

In a breeding Program, you should measure all your accession with all the traits indicated by Bioversity

No – You should choose what are the most important traits to deal with

Are there any differences between Agronomic traits used for conventional and for organic?

Yes, for example, we are interested in measure competition or allelopathy between crop and weeds, which is not important in conventional where herbicides are applied

Nitrogen Use Efficiency (NUE) can be considered a simple trait.

No, because NUE comprises two main components: nitrogen uptake and utilization efficiency, each involving numerous physiological processes and biochemical pathways

Quiz U2.4 + homework

Consider the file "Degustação de Tomate - LIVESEEDING- ESAC 2024". What was the accession with higher acidity.Tomato degustation trial_Ensaio Tomate degustação:

https://app.seedlinked.com/trial/analytics/guest/MjYxMg==

R:631

How many overlapping index cases exist for maize ?https://esacpt-my.sharepoint.com/:x:/g/personal/pmm_esac_pt/EbmeGIzGoKtGntb12adEWiMBKcRyL8KJk7-M1K_irL_a-g?e=4sdzCS

R:13

Proposed homework:

Study case, consider a crop that you are working and identify the five top traits that you would use in a breeding programe for organic.

R: open question depending on the chosen crop