WP2 - Training on organic cultivar testing
Module 8 – Participatory trial methodology

Unit 8.2 Designs for on-farm cultivar evaluation

Julia Cooper & Charlotte Bickler (Organic Research Centre)

Frederik Rey & Ambrogio Costanzo (ITAB)

LiveSeeding

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Module Structure

- Unit 8.1 Introducing the topic – Moving from traditional plot trials to “frugal” trial design
- Unit 8.2 Tools and Methods – Designs for on-farm cultivar evaluation
- Unit 8.3 Case studies from LiveSeeding partners
- Unit 8.4 Practical tips/exercises – Trial design simulation

Reminder of Module Learning Objectives

1. To be able to compare and contrast conventional cultivar evaluation with on-farm, decentralized evaluation, and justify the benefits of decentralized evaluation for organic farming systems.
2. To be able to describe the principle of frugality in on-farm cultivar evaluation and analyze its practical applications for resource-efficient trials.
3. To be able to explain the 'objectives-constraints-methods' approach to trial design and apply it to develop a practical on-farm evaluation plan.
4. To be able to use a decision tree to identify the most appropriate trial design based on specific criteria for on-farm cultivar evaluation.
5. To be able to critically evaluate on-farm cultivar evaluation case studies against the 10 principles of frugal innovation.

Key Resources

Download these now!!!

- Highlights work done in the LiveSeed project on participatory cultivar evaluat hes
- Specifically:
  - Rey et al (2021) Frugal, multi-actor and decentralised cultivar evaluation mod organic agriculture: methods, tools and guidelines. LIVESEED D2.3

Focuses on these two useful booklets:

- Buck et al (2021) Guidelines for organic on-farm cultivar trials. A practical guide for researchers and facilitators LIVESEED booklet
- Riviere et al (2021) Selecting the appropriate methodology for organic on-farm cultivar trials LIVESEED booklet available here
- Both booklets are available here

- Illustrates approaches using case studies from the LiveSeeding project

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Unit 8.2 Outline – how are we going to learn?

1. Deep-dive into decision trees (ppt lecture)
2. Hungarian LIVESEED pilot – video with study questions
3. General discussion – key messages from the videos

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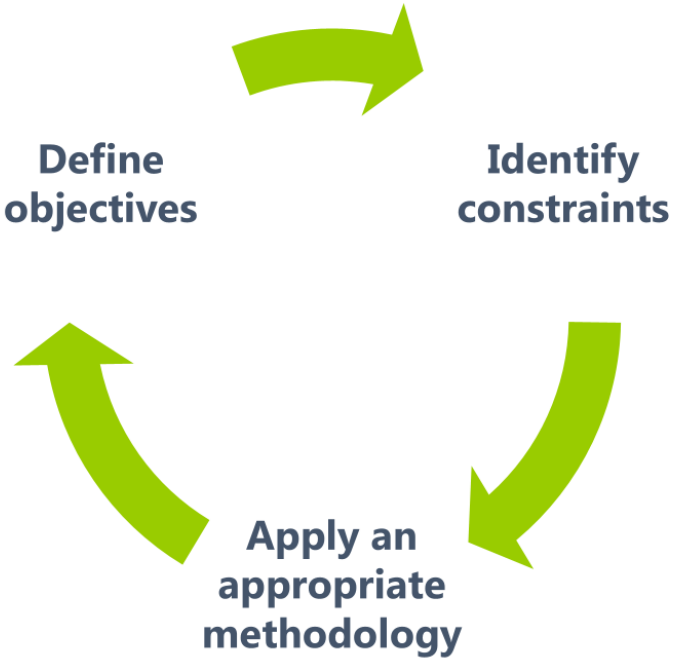
Applying frugal trial design principles

Applying frugal trial design principles

- Refer to this useful booklet from LIVESEED
- Note that it presents ?? Designs
- Remember our frugal trial design process



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Defining objectives

Who gets to define the objectives? What sort of objectives might they be?

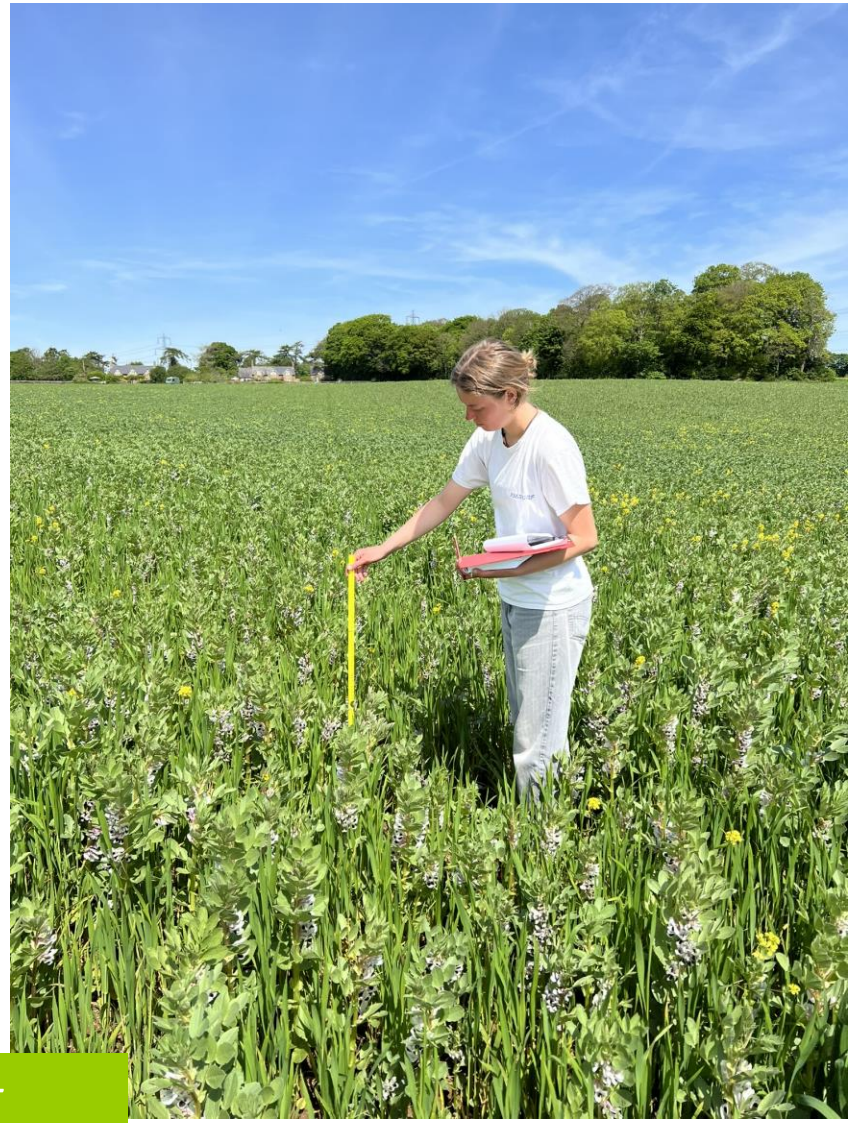
Examples of objectives:

1. To determine the highest yielding variety on my farm.
2. To identify a variety suited to organic bread wheat production in a region.
3. To identify a variety resistant to an emerging disease challenge in a region.

Some constraints associated with on-farm trial design

- Where will the seeds come from?
- How many varieties do we want to test?
- How much labour and equipment will it require? Who will provide?
- What is a practical size for plots per location?
- How many plots be?
- How many replications?
- How many years will we run the trials?
- Others you can think of?

The answers to these questions will determine the trial design



Constraints linked to data

- What data is most relevant to address my objectives?
- What type of measurements will be possible based on – skills of the team, equipment, time, money…?
- Are there tools available to help with data collection (See Module 10)
- Do we have the expertise to evaluate and interpret this data?

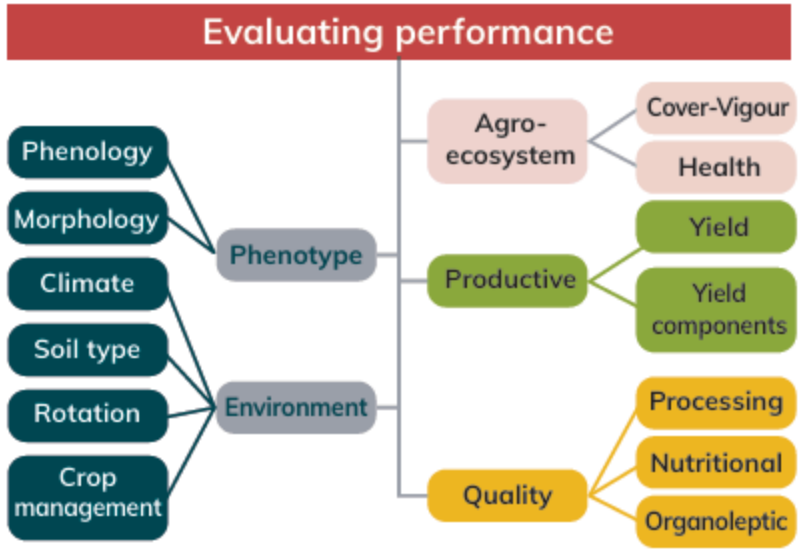


FIGURE 2. Different aspects of trait and environment evaluation (Costanzo [2019])

More on this in Module 9 & 10!

Using decision trees to help design on-farm cultivar evaluation trials

Decision trees for designing on-farm cultivar evaluation trials (Riviere et al 2021)

Two decision trees

1. To compare several varieties at farm level within a network of farms
   - focuses on cultivars' local adaptation at farm scale
   - Appropriate for farmers involved in participatory plant breeding programmes or willing to assess which variety best perform on each farm.
2. To compare several cultivars at network level
   - focuses on broader scales such as regions or pedo-climatic zones
   - Appropriate for stakeholders (farmers, network facilitators, seed companies, cooperatives) wishing to find varieties with broader adaptation

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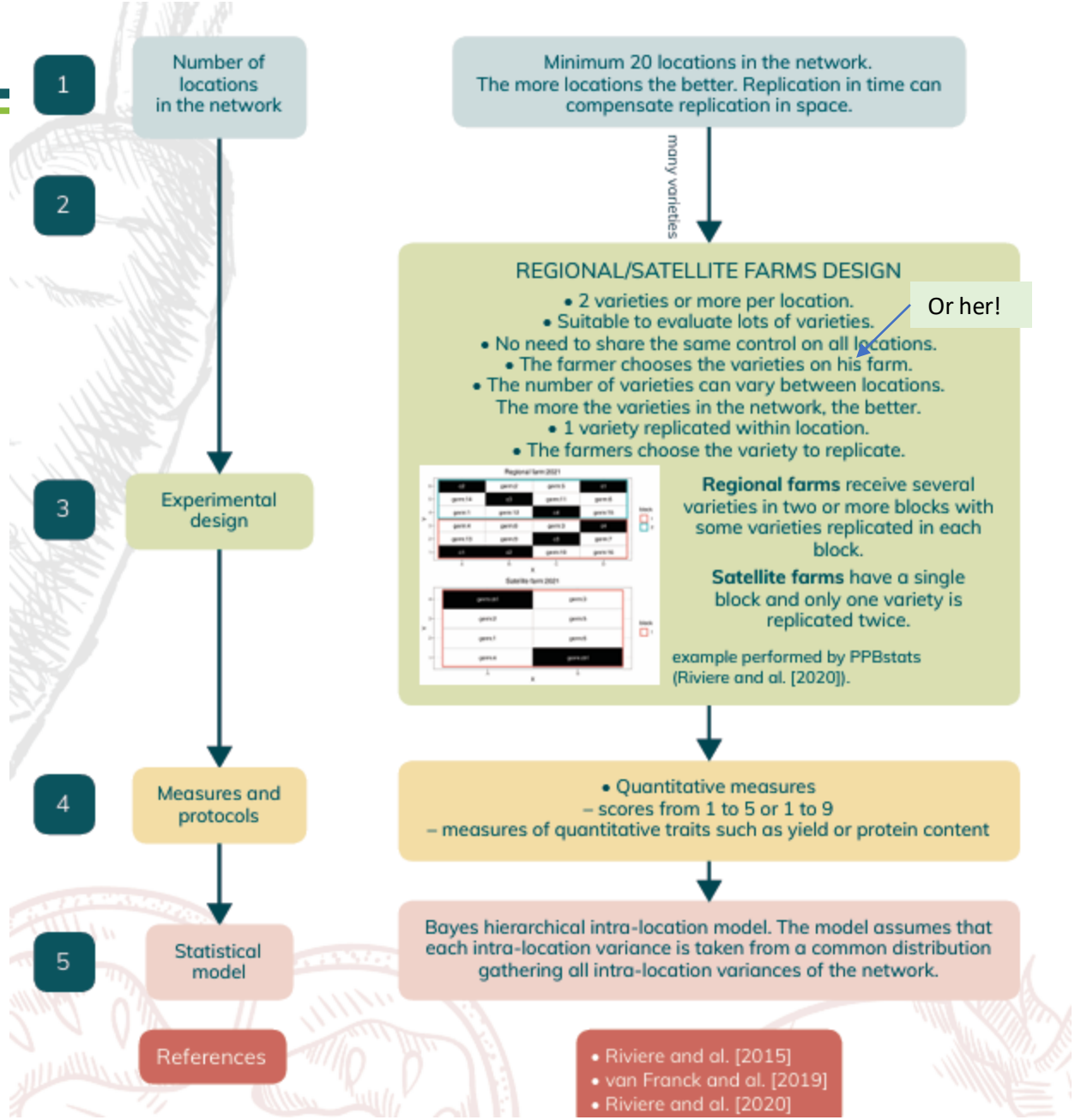
Farm level design route 1

- At least 20 locations
- Many varieties
- No need for a common control, but one variety replicated at each location
- Includes regional farms and satellite farms
- Data – scores and quantitative traits
- But…can also be used for Network level assessments (see decision tree 2, route 2…)



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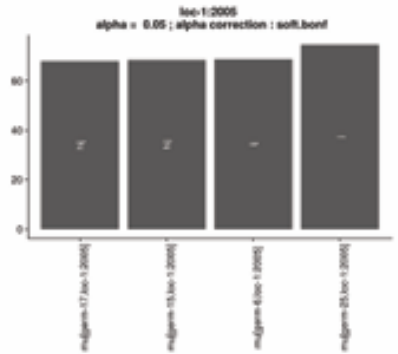
Farm level design route 1 – results, pros & cons

Methods	Results obtained	Staff	Pros	Cons
Bayes intra-location model	• Group(s) of significant differences between varieties. The varieties that belong to the same group are not significantly different.  example performed by PPBstats (Riviere and al. [2020]).	• **Set up the experiments:** On farm trials easy to set up by the farmer. • **Take the measures:** Variables that are measured by assigning a score on a prede-fined scale can be taken by farmers. Quantitative measures can be taken by farmers, technicians or both.	• Simple design for on-farm settings. • Large number of varieties evaluated. • Few seeds needed. • Software available to run the analysis: R package PPBstats https://priviere.github.io/PPBstats_web_site/ • As each farmer chooses the varieties, it is possible to use the design to answer several research questions based on farmers' objectives: varieties' response to selection, adapta-tion, mixtures' evolution, etc.	• Quantitative variables may be difficult to measure accurately: a standard protocol is needed as well as specific equipment.

We need a clearer image of this chart to make it useful/meaningful. Can we get one?

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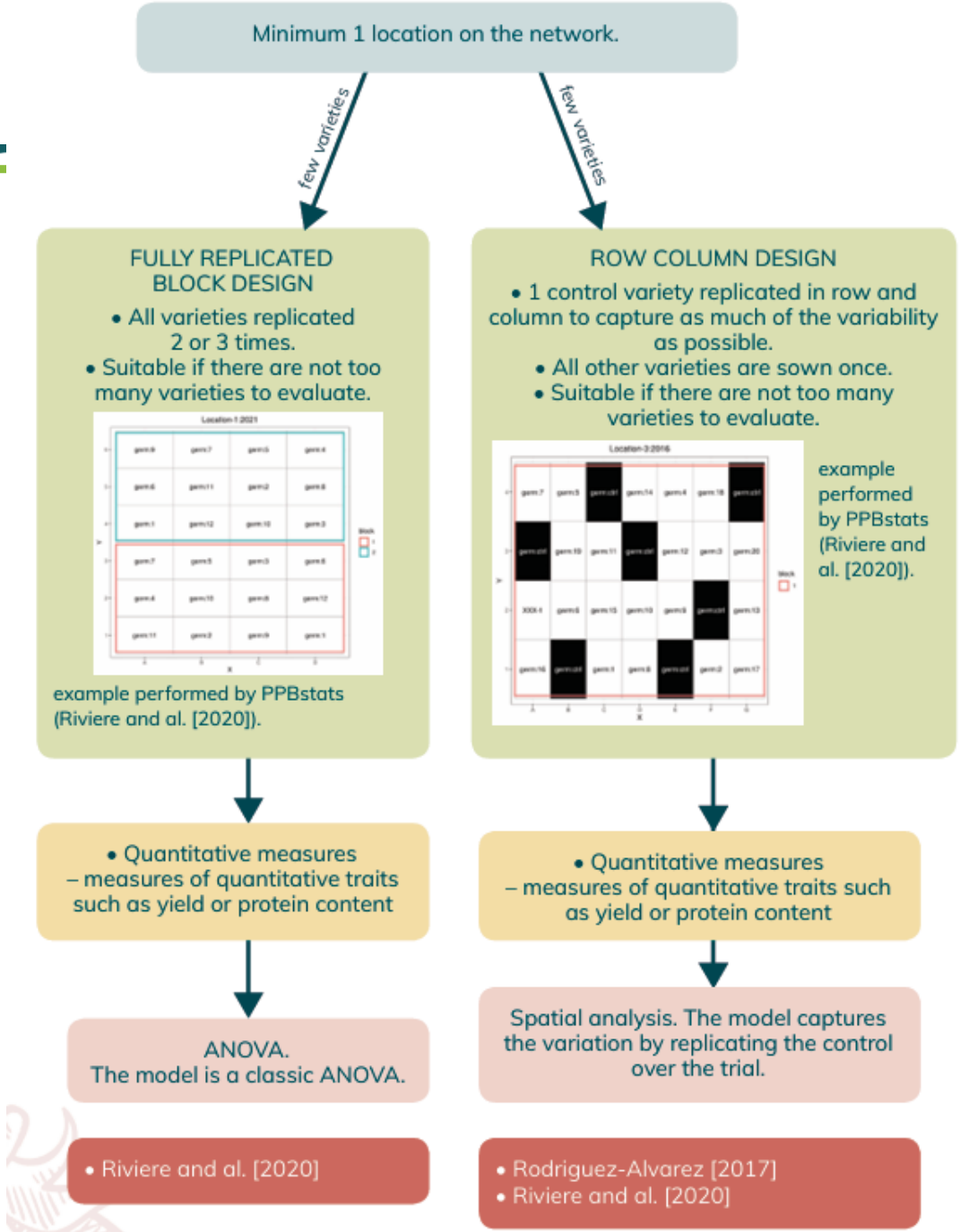
Farm level routes 2 & 3

- Very similar to typical on-station trials used in conventional variety testing
- Could suit organic networks if variety choices and growing conditions are decided collaboratively
- Technicians required to help with trial set up
- Farmers or technicians could collect data (quantitative measures)
- Analysis requires expert input



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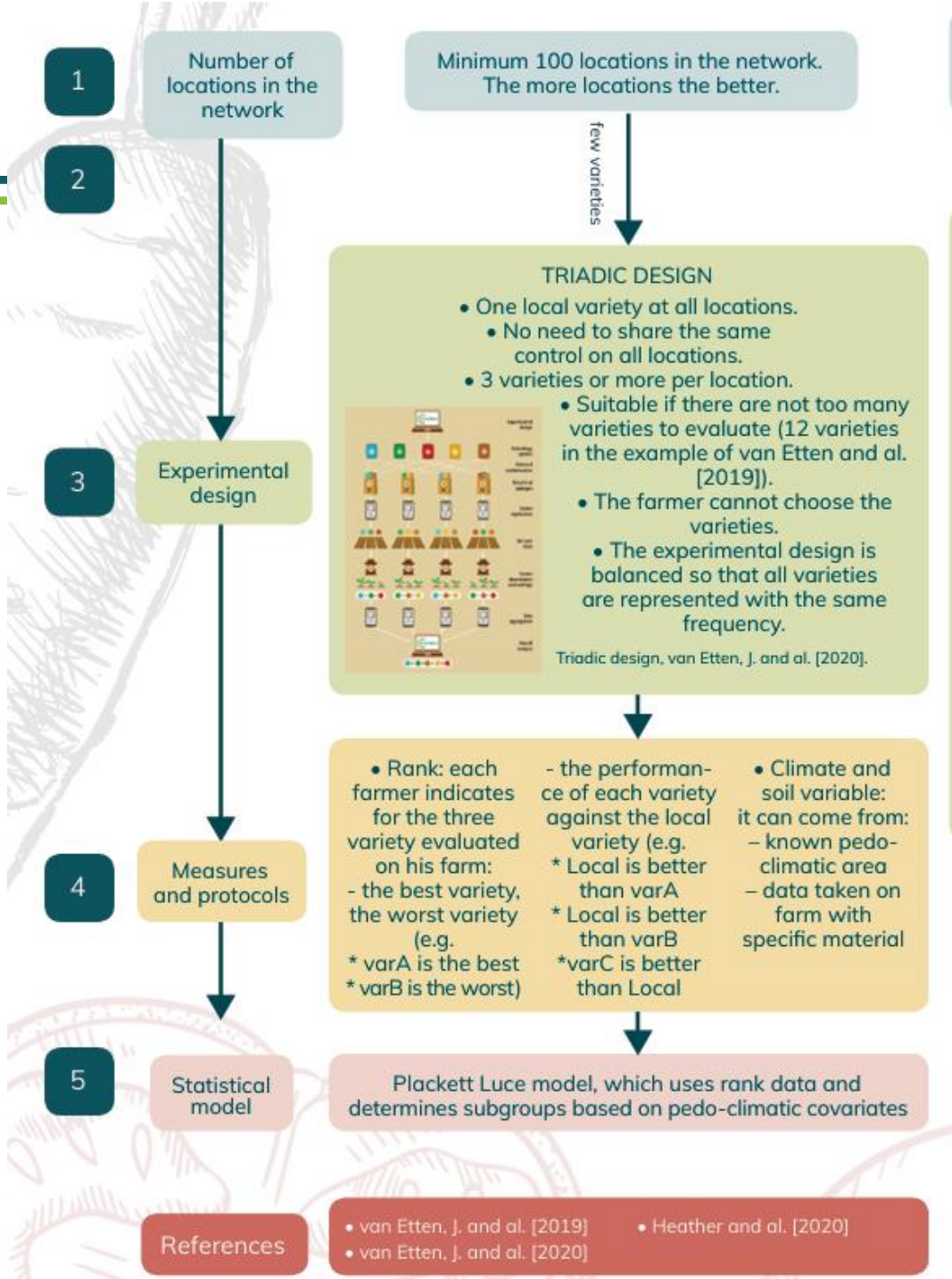
Network level design route 1

- For very large-scale participatory trials
- Less flexibility in variety choice
- Uses data that ranks varieties, not quantitative data
- Know as “tricot” or “triadic” design



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What is a tricot or triadic trial?

From our friend ChatGPT ☺

Tricot stands for **"triadic comparisons of technologies"**. It is a **citizen science approach** desig[illegible]d to scale up participatory research by engaging large numbers of farmers in simple, standard[illegible] experiments.

Key Features:

- Each participant receives **three different treatments**[1] (
- They **rank** or compare them (often without needing to m
- This design **reduces cognitive and logistical burden**—ra[illegible]er than evaluating more.
- The **experimental design is decentralized**, but when aggreg[illegible], the data supports robust statistical analysis.

Find out more about tricot trials on this website

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[1]Could grow more than three varieties, but only three are ranked

Network level design route 1 – example of results obtained

Nicaraguan bean trial

- 10 varieties
- 842 plots
- 2012-2016

"Each farmer ranks the performance of three varieties randomly assigned from a larger set of around 10 varieties + local variety (tricot trial) and sown with a locally known variety."

- 6-8 traits including agronomic traits, yield, consumption value, market value and the 'overall performance', i.e. whether farmers would plant this variety again

Identifies best variety depending on location and nighttime temperature

PR, PO, AP=locations, 15/16=year

TN=maximum nighttime temperature during veg growth

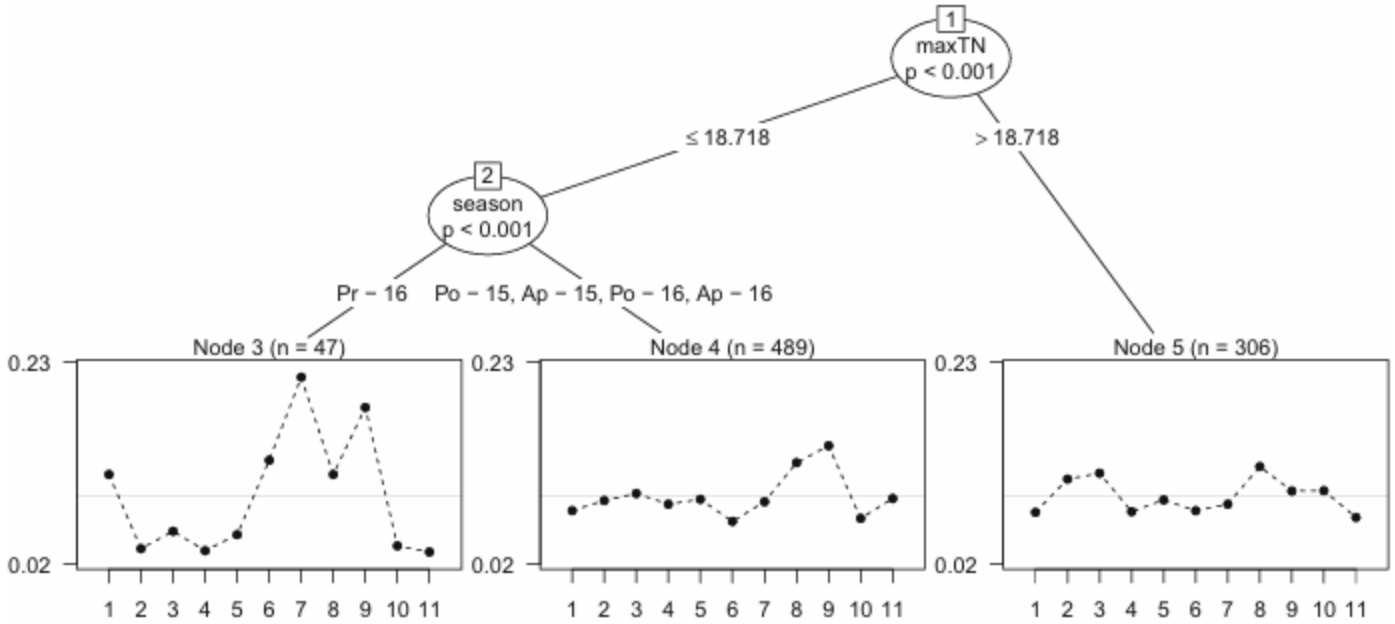

Fig. 4 Worth parameters for the ten trial varieties and the local variety for each node in the Plackett–Luce tree. Varieties are 1: ALS 0532-6, 2: BRT 103-182, 3: INTA Centro Sur, 4: INTA Ferroso, 5: INTA Matagalpa, 6: INTA Precoz, 7: INTA Rojo, 8: INTA Sequia, 9: Local, 10: PM2 Don Rey, 11: SJC 730-79

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More detail in Rey et al 2021; Turner et al. 2020. Computational statistics 35:1027–1057

Network level design route 1 – pros & cons of triadic approach

Staff	Pros	Cons
• **Set up the experiments:** On farm trials are easy to set up by the farmer. • **Take the measures:** ranking data are taken by farmers. Pedo-climatic data are managed by the facilitator.	• Simple design for on-farm settings • Easy protocol to record quality rank data. It can be done by gardeners or farmers even if not used to taking measures. Software available to run the analysis: R package PlackettLuce: https://hturner.github.io/PlackettLuce/index.html	• Great quantity of seeds needed. • Few varieties evaluated. • Many locations needed. • Access to pedo-climatic data may be difficult. • The farmers cannot choose the varieties.

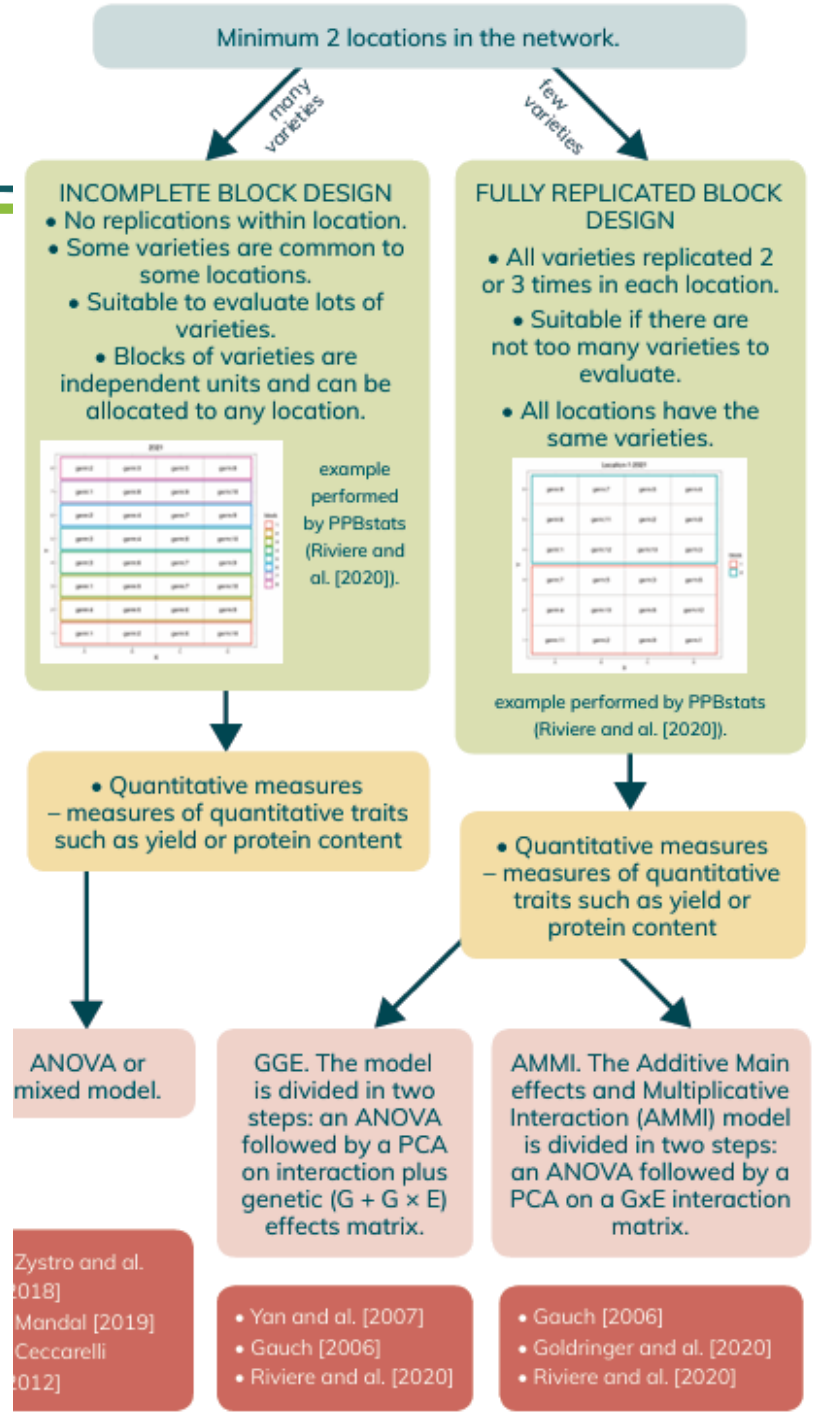
The Nigerian Tricot research team in a Tricot trial farm for cassava

Image: https://www.iita.org/news-item/tricot-a-better-method-for-on-farm-crop-testing/

System level routes 2 & 3

- 2 - Incomplete block design – no need for replications
- Quantitative data

Staff	Pros	Cons
• **Set up the experiment:** on-farm trials can be difficult to set up by the farmer alone. Technicians' help may be required. • **Take the measures:** Quantitative measures can be taken by farmers, technicians or both.	• Simple design for on-farm settings. • Each location has to choose one or several pre-designed variety blocks. Therefore, the experiment can be handled by several locations that cannot receive a high number of plots. • No need for replication on farms. • Software available to run the analysis: - ibd: https://cran.r-project.org/web/packages/ibd/index.html - lme4: https://cran.r-project.org/web/packages/lme4/index.html - lmerTest: https://cran.r-project.org/web/packages/lmerTest/index.html	• It may be difficult to establish an on-farm trial if many varieties are evaluated. • Quantitative variables may be difficult to measure accurately: a standard protocol is needed as well as specific equipment.



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Hungarian case studies – participatory cultivar evaluation in practice

Video instructions

- Open the file with directed questions and fill in your answers as you watch the video

The videos are located at these links:

1. Miért érdemes újra felfedezni az ősi ~~201~~gabonákat? - Rediscovery of ancient landrace cereals
2. EGYÜTTMŰKÖDÉS A TÁJFAJTA ŐSGABONÁKÉRT - A LIVESEED pilot Magyarországon - COOPERATION FOR ANCIENT GRAINS - The LIVESEED pilot in Hungary
3. Organic winter wheat and ancient grain variety tests in Zseliz, Biocentrum organic farm, Slovakia
4. Organic variety tests and product development at Csoroszlya Farm

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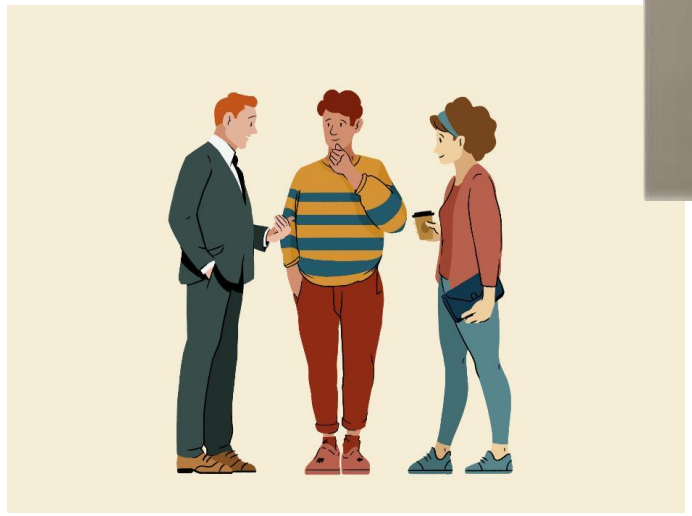
Discussion of Hungarian case studies

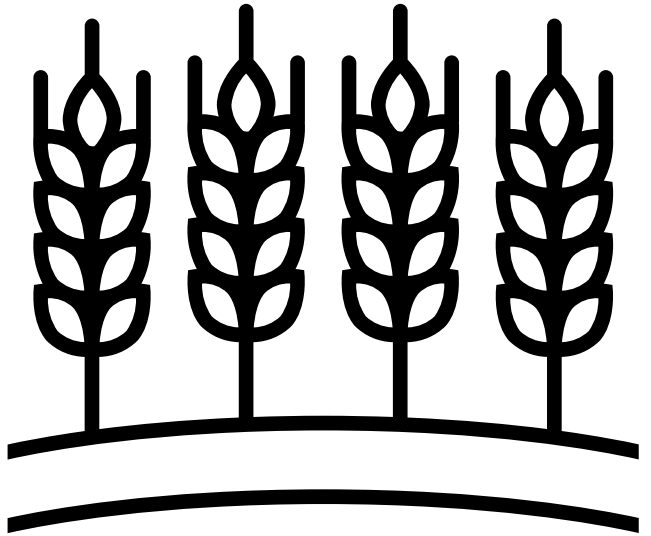
What are ancient grains and landraces?

Which ancient grains are mentioned in the videos?

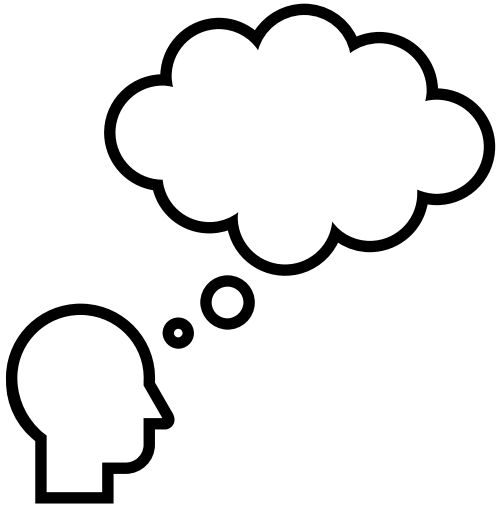


Why are ancient grains suited to organic systems?

Can you think of agronomic and economic reasons why they might be attractive, especially in organic systems?



Discuss how the trials described in the videos were participatory. How were different actors involved along the value chain?

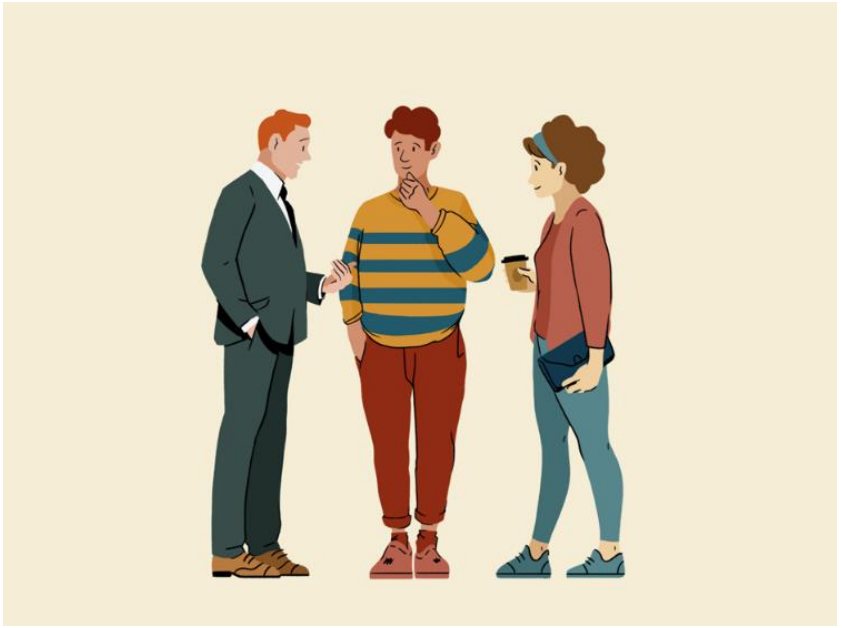


Describe the steps taken in testing and promoting ancient cereals in the ~~Magyarországon~~ Hungarian pilot

Delegates from the International Wheat Congress visiting a wheat field trial in York, Western Australia. Credit: Murdoch University

The Csoroszlya Farm project

Describe the value chain included in the Csoroszlya Farm project? What different testing activities took place along the value chain? What were the positive outcomes of this approach? In what ways was this project similar to conventional variety testing? How was it different?



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