

#WEBINAR

CULTIVAR TESTING MODELS

With Mr. Pierre Rivière and Mr. Jacob van Etten

3rd of September 2020

17-19:00 PM CET

Laura Le Du, IDEAS

Frederic Rey, ITAB, WP2



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.



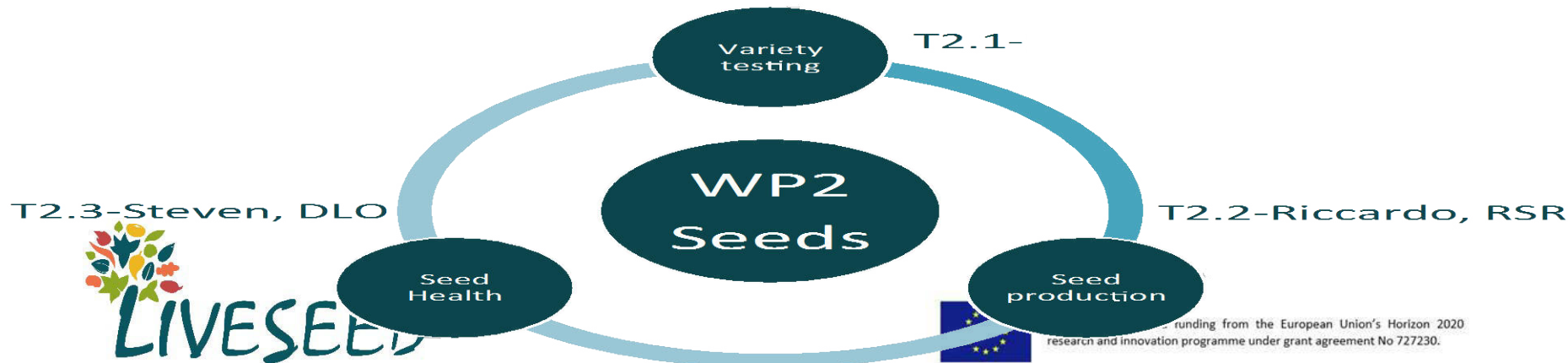
T2.1.1
Cultivar testing
& organisational
models
ÖMKI

**D 2.3 - Optimised
cultivar trials for
organic
agriculture:
methods, tools
and guidelines
(M42 =Nov. 2020)**

Design (workshops)

new organisational models,
considering EU countries with limited or
no infrastructure. Emphasis will be
placed on on-farm and participatory
trials, and on alternative funding
models.

- First workshop: 5 Feb. 2020, Brussels
- **Webinars:** 3 Sept. 2020
- 2nd workshop: 23-24 Sept. 2020,
online



WEBINAR Programme

17:00-17:05	Introduction Laura Le-Du, Frédéric Rey
17h05-17h45	Experimental designs and statistical methods and tools relevant for decentralized on-farm breeding Pierre Rivière
17h45 – 18h25	How can citizen sciences be applied for cost-efficient organic variety testing in Europe Jacob van Etten (Alliance Bioversity-CIAT)
18h25 – 19h00	Discussion



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

WEBINAR Discussion

18h25 – 19h00: **Discussion**

To which extent do these presentations challenge current cultivar testing network organisation?

- How tools and methods presented do provide inputs to re-design cultivar testing networks?
- How citizen sciences could be helpful to transform the organization of cultivar testing networks? What are the success factors?
- How does it question the functions of traditional actors in networks? Who could be the new actors in the future? Which connections between these new actors?



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Experimental designs and statistical methods and tools relevant for decentralized on-farm breeding

Pierre Rivière



3rd september 2020



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

- 1 Introduction
- 2 Agronomic analyses
- 3 Sensory analyses
- 4 Network analysis
- 5 PPBstats software
- 6 Perspectives



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Objectives

Objectives :

- present that efficient design and statistical methods and tools for field trials in organic agriculture exist.
- discuss how to think network trial organisation in organic agriculture knowing this?



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

The interest of decentralizing selection

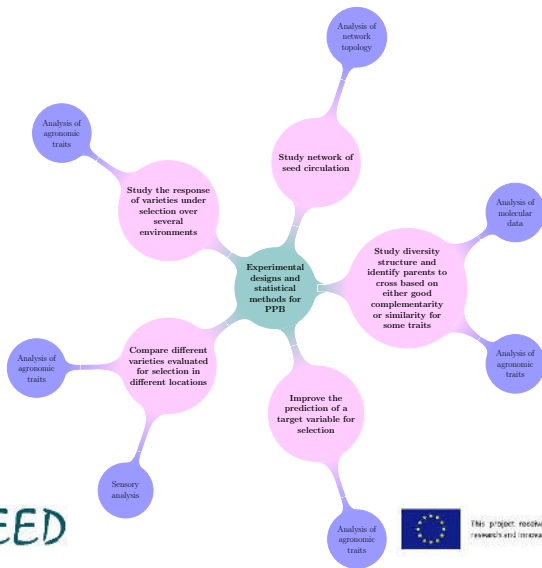
- organic agriculture : heterogenous environment and practices
- valorize $G \times E$ interaction : evaluation in real condition on farm
- large network :
 - diversity of environment and practices
 - high number of varieties
 - statistical robustness

Decentralisation of selection reach its objectives when all actors are invovled in the breeding decision process



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

The analyses of data from PPB programmes aim to address different objectives.



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

For each objective, there are several methods based on different experimental designs based on

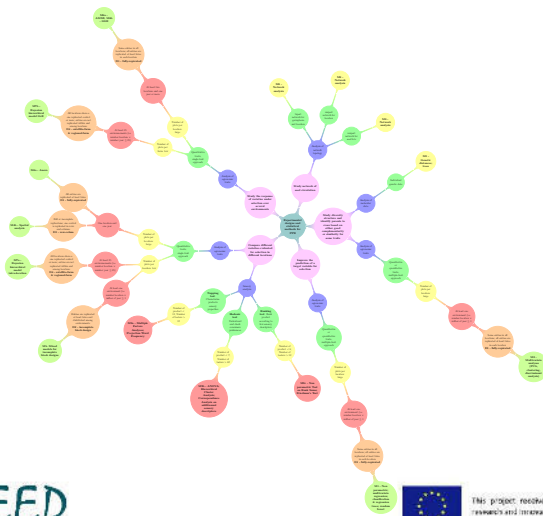
- the number of plots per location,
- the number of locations,
- the number of replicated germplasms within and between locations
- ...

all being dependant to the amount of seeds available ... and with often high disequilibrium !



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Decision tree



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

- 1 Introduction
- 2 Agronomic analyses**
- 3 Sensory analyses
- 4 Network analysis
- 5 PPBstats software
- 6 Perspectives



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Two examples of objectives and analysis

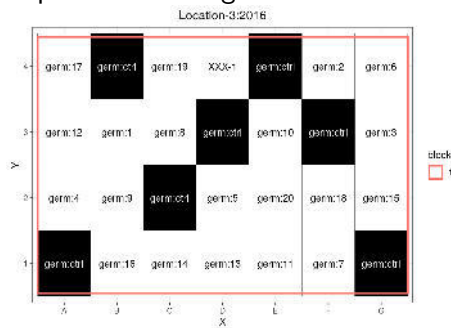
- Compare different varieties evaluated for selection in different locations.
 - classic anova based on on fully replicated designs,
 - spatial analysis based on row-column designs, mixed models for incomplete blocks designs,
 - bayesian hierarchical model intra-location based on satellite-regional farms designs
- Study the response of varieties under selection over several environments.
 - AMMI and GGE based on on fully replicated designs
 - bayesian hierarchical model $G \times E$ based on satellite-regional farms designs



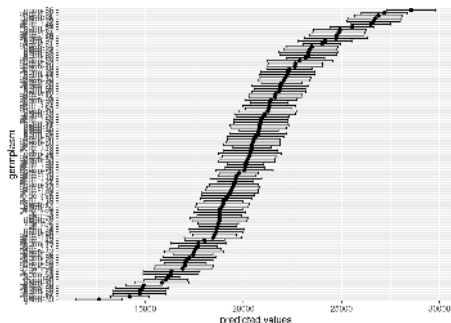
This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Spatial analysis

Experimental design



- 1 Run the model
- 2 Check the model
- 3 Get blups and compare means

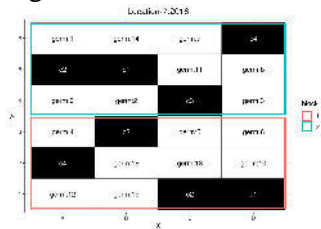


This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

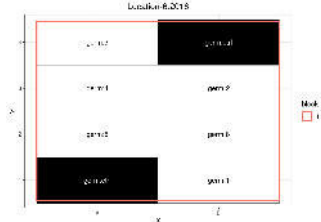
Bayesian hierarchical model on G x E

Experimental design

regional farm

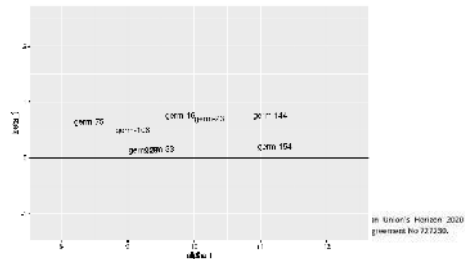


satellite farm



- 1 Run the model
- 2 Check the model
- 3 Get effects on germplasm, location and sensitivity to interaction

Sensitivity to interaction vs germplasm effect

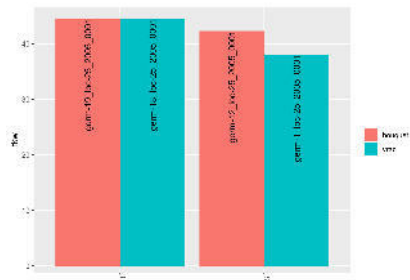


Examples of specific research questions

Study response to selection :

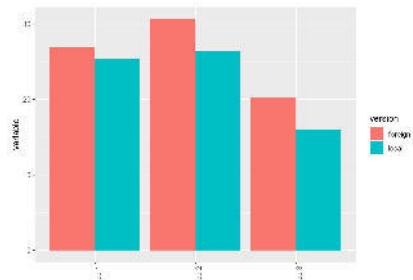
$$R = h^2S$$

- 1 Run the model
- 2 Check the model
- 3 Get means comparison and compare version effects



Study local adaptation

- Run the model (home away and local foreign)
- Check the model
- Get means comparison and compare version effects



Swain 2020
727230

- 1 Introduction
- 2 Agronomic analyses
- 3 Sensory analyses**
- 4 Network analysis
- 5 PPBstats software
- 6 Perspectives



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Two examples of objectives and analysis

- Understand and check consumers preferences : hedonic analysis
- Characterize products sensory properties : napping analysis

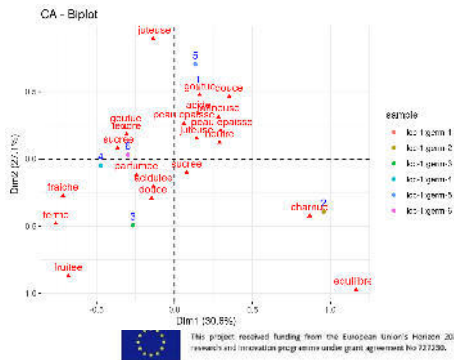


This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Hedonic analysis

Experimental design : judges taste samples and give a note and descriptors

- 1 Run the model
- 2 Check the model
- 3 Get mean comparisons and CA

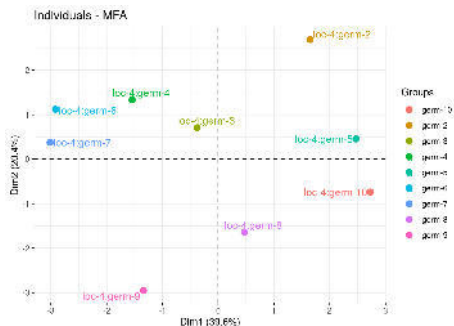


Napping analysis

Experimental design : judges sort and place samples on a paper, then give descriptors on group of samples



- 1 Run the model
- 2 Check the model
- 3 Get MFA



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

- 1 Introduction
- 2 Agronomic analyses
- 3 Sensory analyses
- 4 Network analysis**
- 5 PPBstats software
- 6 Perspectives



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Two examples of objectives and analysis

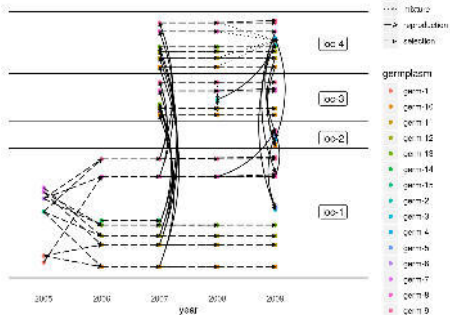
- Study topology of unipart network where nodes are seed lots (i.e. a combinaison of a germplasm in a given location a given year) and edges are relationships such as diffusion, mixture, reproduction, crosses or selection for example.
- Study topology of bipart network where nodes are either location or germplasm



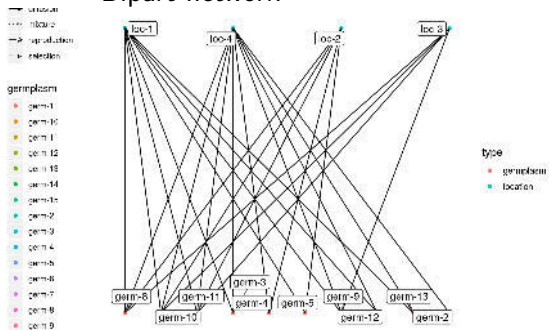
This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Study topology of seed network

Unipart network



Bipart network



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

- 1 Introduction
- 2 Agronomic analyses
- 3 Sensory analyses
- 4 Network analysis
- 5 PPBstats software**
- 6 Perspectives



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

PPBstats is a freely available package based on the R software that performs analyses on the data collected during PPB programs at four levels :

- network of seed management
- agronomic trials in order to set, describe and analyse balanced and unbalanced trials
- organoleptic tests
- molecular experiments

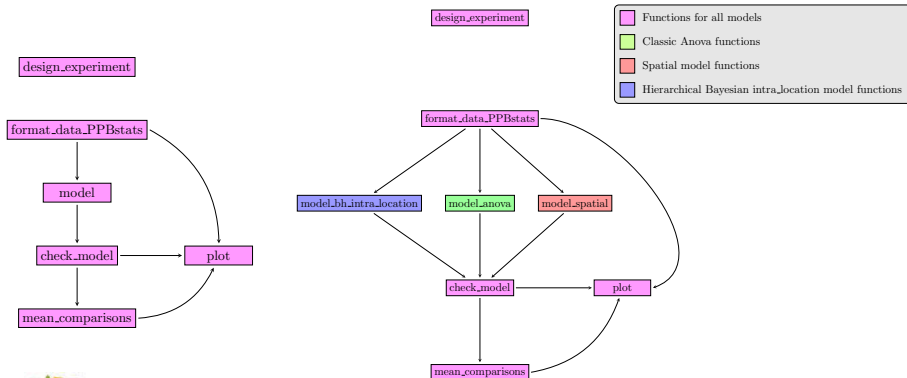
The objectives of PPBstats are

- to have a single package capable of performing all analyses required for PPB programmes with comprehensive documentation, and
- to create a community working on PPB programmes in order to improve the package, exchange on how to process data from PPB programmes and develop good practices.



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Workflow



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Reports back to farmers

It is important to give results back to the farmers in order to discuss results and accompany them in their selection.

This can be done through the creation of reports with results coming from the analysis.

Report can be done automatically for each farmer participating to the programme.



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Website

https://priviere.github.io/PPBstats_web_site/index.html

- Exhaustive tutorial
- Contributing guide



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Perspectives

The design and statistical methods for field trial exist and work if it is participatory :

- easy and flexible protocols (one control, choose main variables, ...)
- free software to run analysis available

The main task seems to coordinate a (regional? national? international?) network that can use it :

- agree on a control and common variables to measure (agronomic, ecosystem services, etc)
- do the measures (farmers, facilitators, researchers, ...)
- organize data and analyse it
- give information back and discuss it



New socio-technical organisational models to create !

Copyright Collectif Mètis.

This document is under licence creative commons BY-NC-SA.



To cite this document : *Experimental designs and statistical methods and tools relevant for decentralized on-farm breeding. 3 september 2020. Pierre Rivière. Collectif Mètis. Presentation support. Licence CC BY NC SA.*



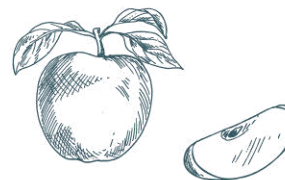
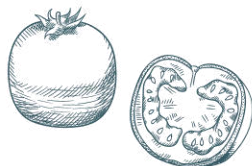
This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.



Citizen science for variety testing

Jacob van Etten

Alliance of Bioversity International and CIAT (CGIAR)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.

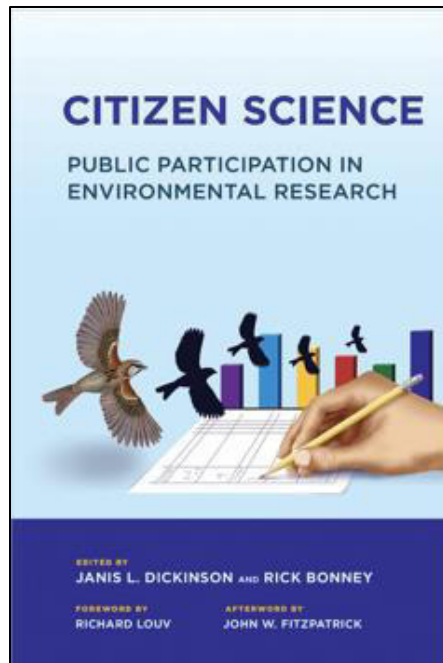


Some issues with current on-farm testing

- Sometimes difficult to find farmers with capacity (large plots, complex layout)
- Supervision + training increments costs
- Difficult to execute and understand for farmers themselves
- Data collection requires timely visits and data return is generally slow and low
- Low number of plots and unrepresentative management (due to need for experimental control to reduce variance) lead to low external validity



Citizen science



Citizen science for variety testing

- Variety evaluation in hands of farmers – cost externalization
- Farmers as motivated “citizen scientists” – invert incentives
- Make it simple – little supervision and training
- Go digital – reduce errors, staff needs, ensure quick feedback
- Rethink the statistics – should work for farmer observation
- Analyze GxE – link environment and crop management

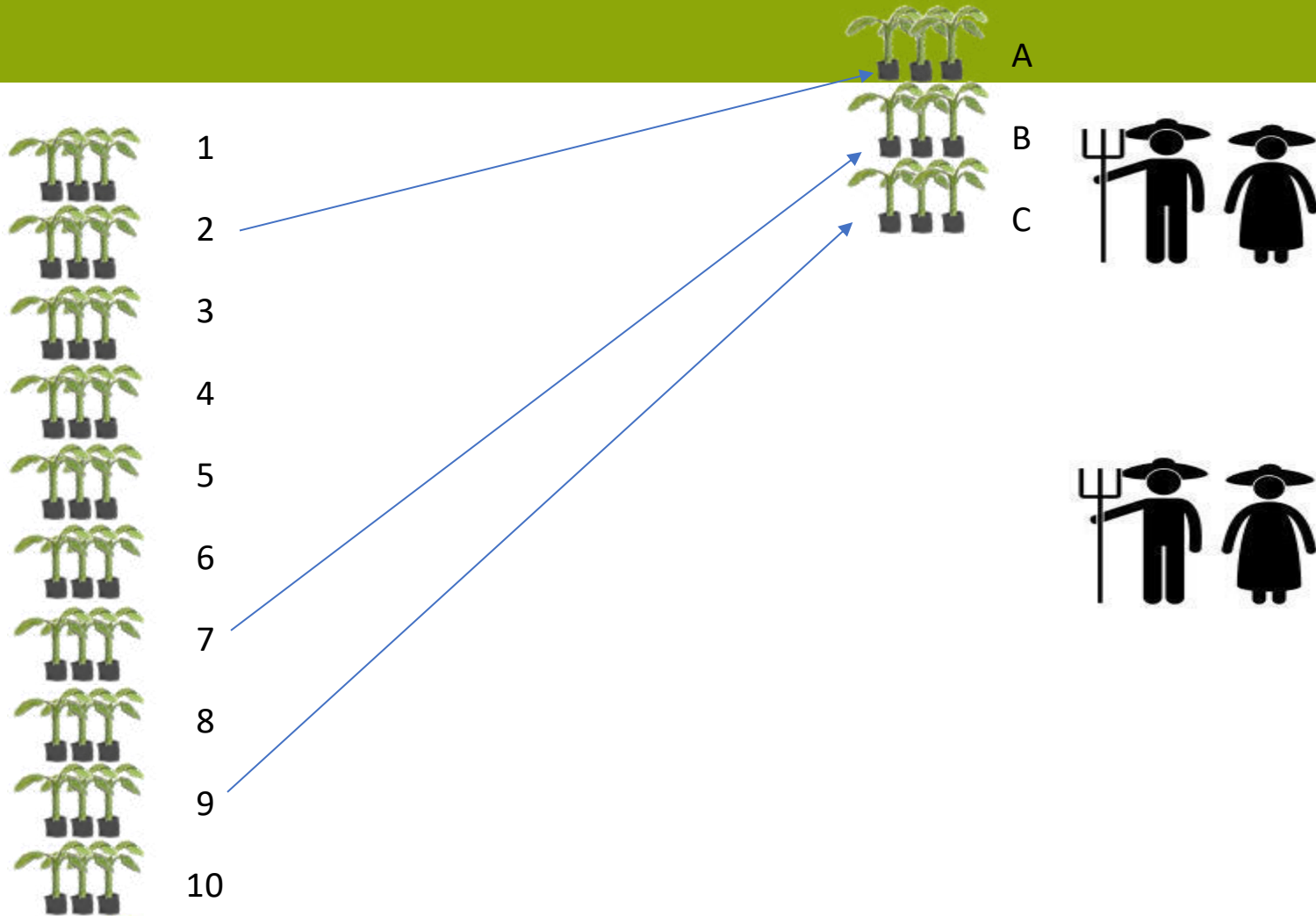


The approach: tricot

- Farms as Incomplete Blocks
- Ranking as main approach for data collection: makes it easier to assess the varieties and compare across sites
- Blind testing reduces bias
- Digital platform to streamline the process: for data collection and analysis → faster feedback to farmers
- Embrace variation in environment and crop management:
 - Experimental control → observation
 - Positive appreciation of GxE (not just minimize GxE and isolate G)
- **Triadic comparison of technologies**

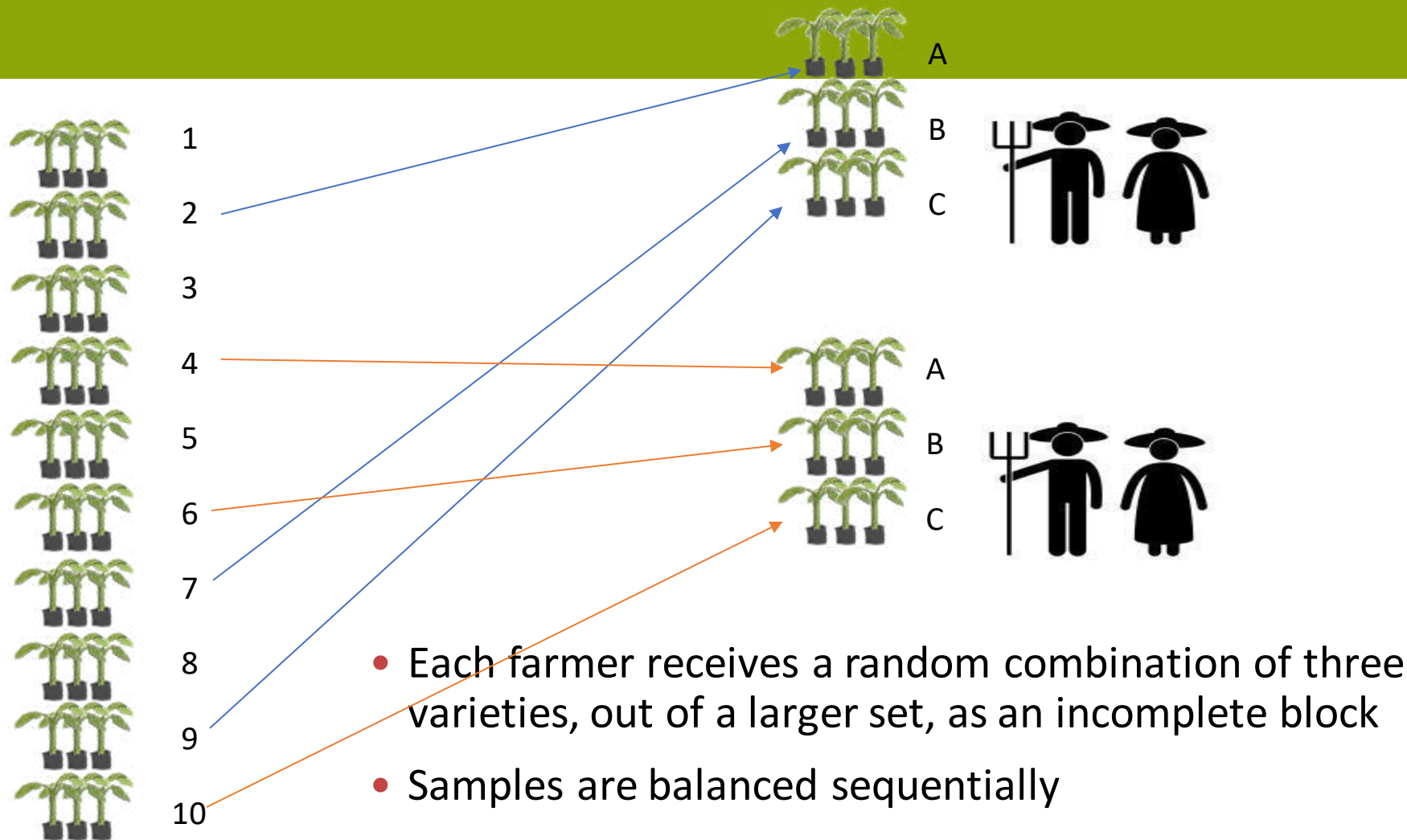


Experimental design

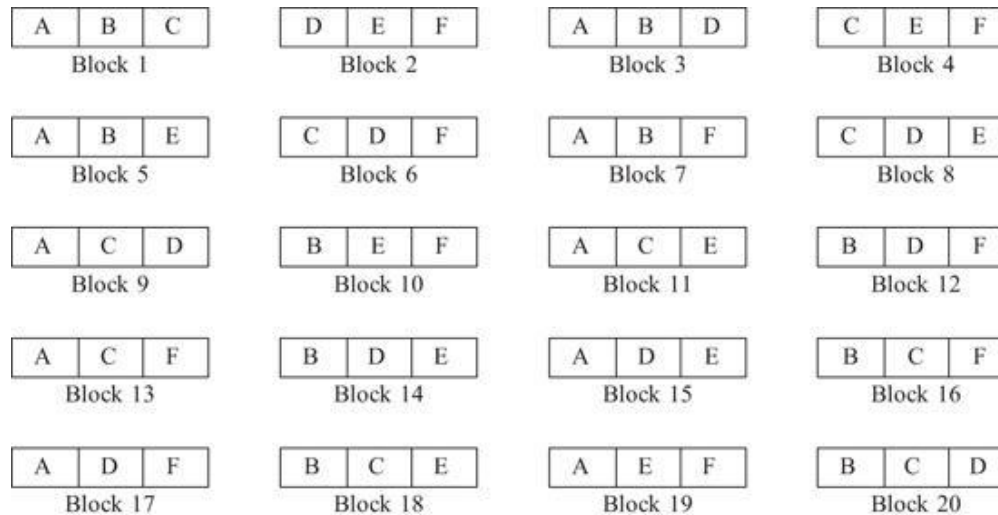


This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Experimental design



Farms as incomplete blocks



¡Participar es fácil! Aquí le explicamos todo

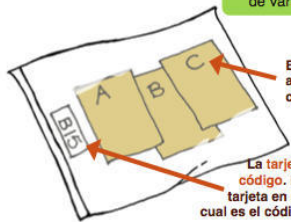
Paso 1. Inscríbese como participante



Un técnico tomará sus datos: nombre y apellidos, número de teléfono y dónde se encuentra su parcela de siembra.

Paso 2. Abra su paquete y descubra lo que contiene

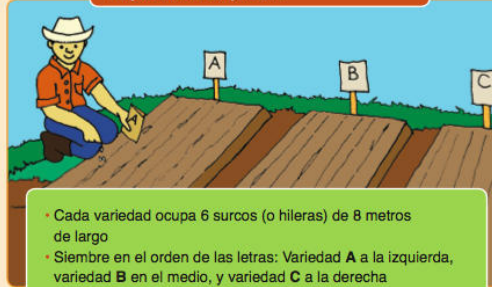
Tres sobres con semilla de variedades mejoradas.



Es muy importante acordarse de cuál letra es cuál semilla.

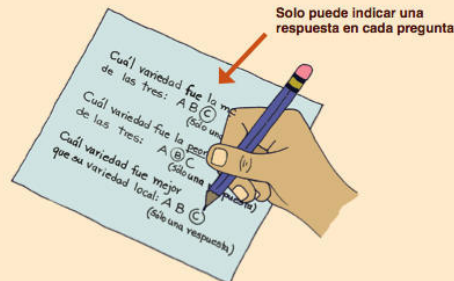
La tarjeta de observación tiene un código. Es importante guardar esta tarjeta en un lugar seguro para saber cuál es el código de su paquete después.

Paso 3. Siembre las semillas de las variedades mejoradas en su parcela



- Cada variedad ocupa 6 surcos (o hileras) de 8 metros de largo
- Siembre en el orden de las letras: Variedad **A** a la izquierda, variedad **B** en el medio, y variedad **C** a la derecha (de preferencia en el lote dónde sembró o sembrará su **variedad local**)
- ¡Recuerde bien donde quedó sembrada cada variedad!
- Siembre la semilla de las variedades A, B y C de la misma forma que sembró su variedad local. Maneje las parcelas como lo hace normalmente en su parcela de frijol.

Paso 4. Complete la tarjeta de observación



Solo puede indicar una respuesta en cada pregunta

Paso 5. Conteste al encuestador por teléfono



- Cuando llama el encuestador, busque su tarjeta de observación.
- Conteste las preguntas con mucha precisión.

Paso 6. Reciba la información sobre las variedades sembradas

El técnico le llamará por teléfono y le explicará:

- ¿Cuáles son las variedades que usted sembró?
- ¿Cómo usted y otros agricultores evaluaron las variedades?
- ¿Cuál es la variedad que se recomienda para su parcela?
- ¿Cómo puede obtener semilla de las variedades mejoradas?

Paso 7. Comparta información y semillas con sus vecinos



- Cuento a sus vecinos sobre su experimento durante el desarrollo del cultivo y después de la cosecha.
- Comparta un poco de semilla de las mejores variedades para que ellos también las prueben.



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Plackett-Luce model

best worst

farmer 1  $A > C > D$

farmer 2  $C > D > G$

farmer 3  $A > D > G$







$A > C > D > G$

Computational Statistics
<https://doi.org/10.1007/s00180-020-00959-3>

ORIGINAL PAPER



Modelling rankings in R: the PlackettLuce package

Heather L. Turner¹  · Jacob van Etten²  · David Firth^{1,3}  ·
Ioannis Kosmidis^{1,3} 

Received: 30 October 2018 / Accepted: 18 January 2020
© The Author(s) 2020

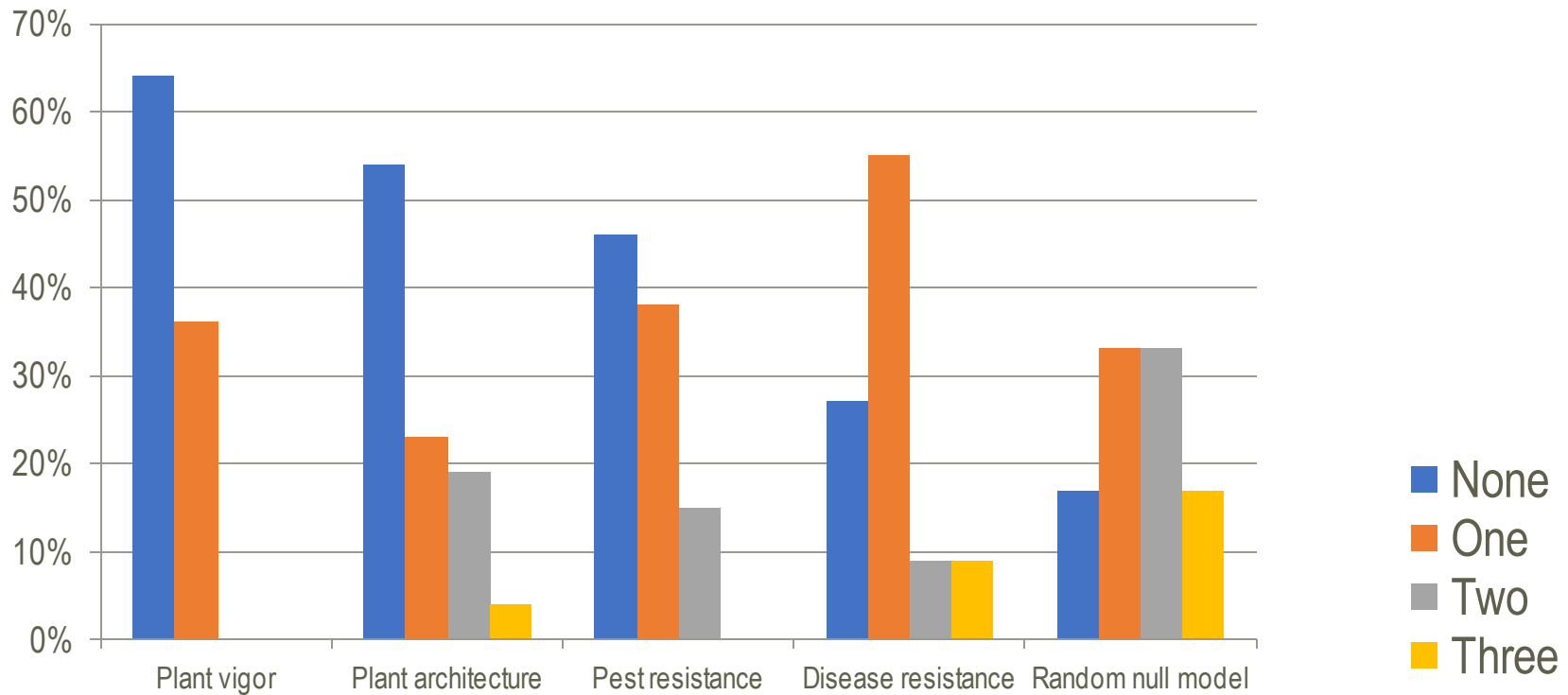
Abstract

This paper presents the R package **PlackettLuce**, which implements a generalization of the Plackett–Luce model for rankings data. The generalization accommodates both ties (of arbitrary order) and partial rankings (complete rankings of subsets of items). By default, the implementation adds a set of pseudo-comparisons with a hypothetical item, ensuring that the underlying network of wins and losses between items is always strongly connected. In this way, the worth of each item always has a finite maximum likelihood estimate, with finite standard error. The use of pseudo-comparisons also has a regularization effect, shrinking the estimated parameters towards equal item worth. In addition to standard methods for model summary, **PlackettLuce** provides a method to compute quasi standard errors for the item parameters. This provides the basis for comparison intervals that do not change with the choice of identifiability constraint



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Are farmers accurate?

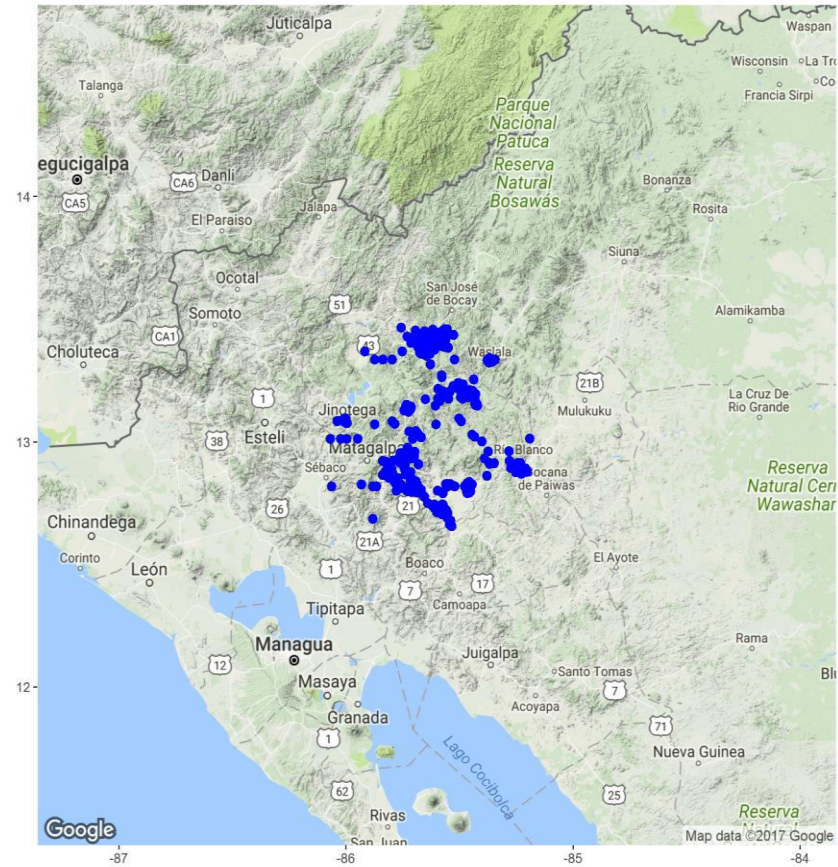


Steinke et al. (2017) *Agronomy for Sust. Devt.*



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Nicaragua common bean



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

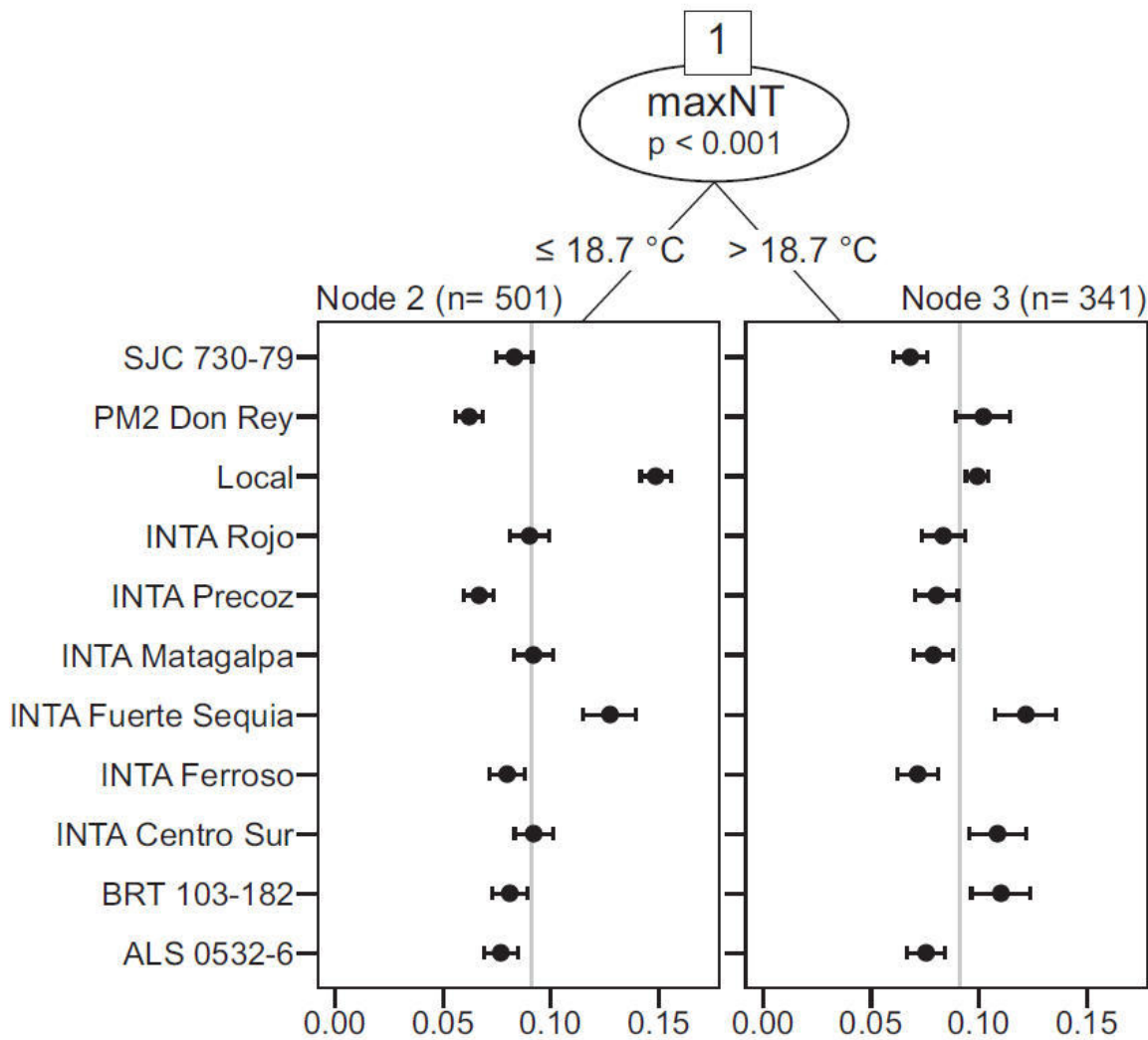
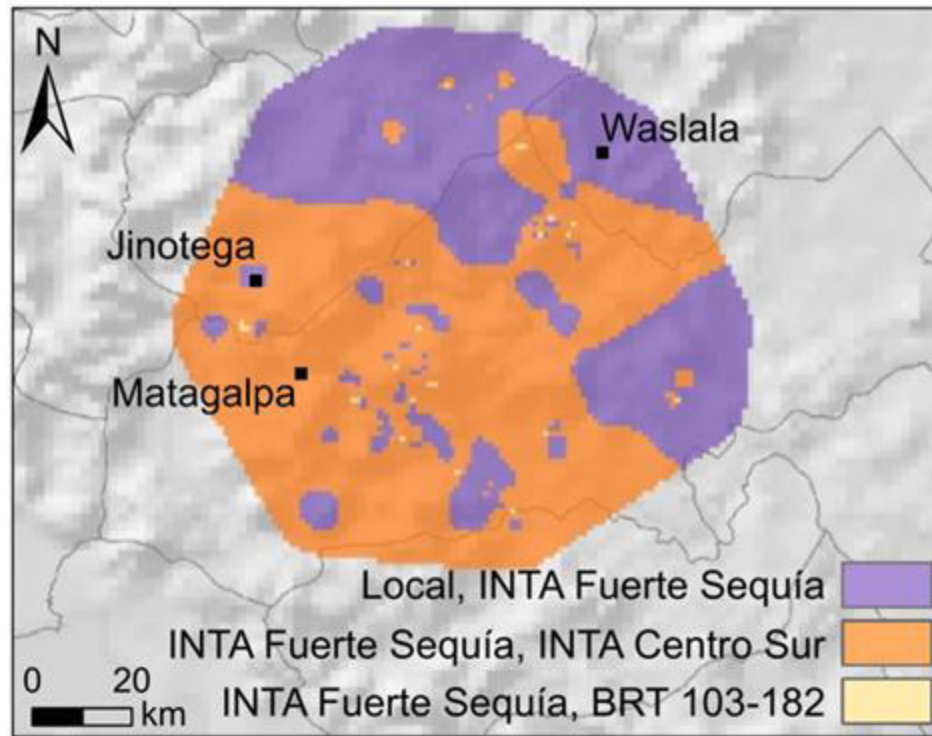


Fig. 2. Plackett–Luce trees of tricot trial data and associated climatic data for common bean in Nicaragua. The horizontal axis of each panel is the probability of winning of varieties. Error bars show quasi-SEs. The gray vertical lines indicate the average probability of winning (1/number of varieties). In this case, the model selected maxNT, the maximum night temperature (degrees Celsius) during the vegetative and flowering periods, as the covariate. Equivalent figures for the trials in Ethiopia and India are shown in *SI*



Past and ongoing experiences

- Common bean, Central America (5 countries)
- Durum wheat, Ethiopia
- Bread wheat and rice, India
- Cocoa, Ghana
- Multiple crops, ISSD, Ethiopia (scaling)
- Multiple crops, Bioversity-GEF, India
- Cassava, IITA/Cornell, Uganda, Nigeria
- Maize, Seed Co, Zimbabwe
- Maize, potato, cassava, One Acre Fund, Rwanda
- SeedLinked, USA, digital platform working with seed savers, organic breeders
- Sweetpotato, CIP, consumer testing, Uganda and Ghana



“spin-off” company will provide services

ClimMob platform

ClimMob Log out Projects

Cassava Rwanda 2020

Project definition 100% Completed

- Assign field agents Completed
- Select technology options Completed
- Prepare registration Completed
- Prepare data collection Completed

Share this link to show trial progress:

<https://testing.climmob.net/climmob3/projectInformation/239ccb4ffa4555a9682092a80ef319:c3>

[Copy to clipboard](#)

[Update project settings](#) [Delete project](#)

Data Collections

Please check the following types of questions are in the started assessments or include them in the next assessments:

- ✓ Ranking of options
- ✗ Comparison with check
- ✗ Explanatory variables
- ✓ Overall ranking of options
- ✓ Overall comparison with check

[Start an assessment](#)

Participant registration Closed

Data collection: FinalEvaluation Closed

Statistics

Total number of participants:	13
Number of submissions:	11 (84.6%)
Submissions with conflicts:	1
Last submission:	47 days ago

[View data](#)

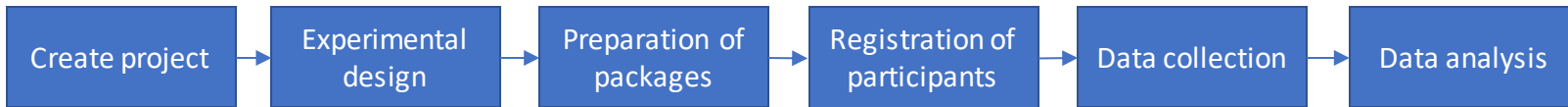
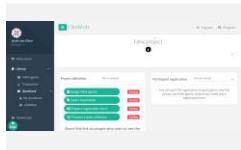
[Download data](#)

Analysis

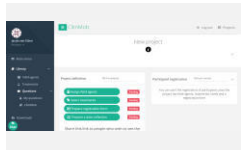
[Select variables to analyze](#)



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.



Create project

Experimental design

Preparation of packages



Registration of participants

Data collection


Data analysis




 QR field agents

 QR packages
 Randomization

 ODK registration form

 ODK data collection forms

 } Analytical report


 Infosheets for participants



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

Reconfiguring variety testing

- Streamlined digital process
- Substantial farmer involvement without overload
- Higher external validity and more insight in GxE
- Low technical requirement – can be expanded in European contexts (smartphones, sensors, etc.)
- Scope for different business model in variety testing (for example, SeedLinked)

