Participatory Varietal Selection of Potato
Using the Mother & Baby Trial Design:
A Gender-responsive Trainer’s Guide

Participatory Varietal Selection of Potato, sweet potato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.

www.cipotato.org

CIP is a CGIAR research center.
CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 research centers in close collaboration with hundreds of partners across the globe.

www.cgiar.org

The European Union is made up of 27 Member States who have decided to gradually link together their know-hows, resources and destinies.

Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms.

The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

EUROPEAN UNION

Participatory Varietal Selection of Potato
Using the Mother & Baby Trial Design:
A Gender-responsive Trainer’s Guide
Participatory Varietal Selection of Potato Using the Mother & Baby Trial Design: A Gender-responsive Trainer’s Guide
© International Potato Center, Lima, Perú, 2019.

ISBN: 978-92-9060-538-6
DOI: 10.4160/9789290605386
Hecho el Depósito Legal en la Biblioteca Nacional del Perú No 2019-17373

This document was produced at the conclusion of the project Advancing Achievements in Breeding for Early, Resilient and Nutritious Potato and Sweetpotato, implemented by the International Potato Center (CIP). The project was funded by the United States Agency for International Development (USAID), the Regional Program for Research and Innovation by Agricultural Value Chains–PRIICA (European Union/Inter-American Institute for Cooperation on Agriculture), and the CGIAR Research Program on Roots, Tubers and Bananas.

This manual has been produced with the technical support of the European Union within the framework of the Benefit-sharing Fund project "Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan" of the FAO’s International Treaty on Plant Genetic Resources for Food and Agriculture. The views expressed in this document are those of the author(s) and do not necessarily reflect the views or policies of the European Union or FAO.

CIP publications contribute important development information to the public arena. Readers are encouraged to quote or reproduce material from them in their own publications. As the copyright holder, CIP requests acknowledgment and a copy of the publication where the citation or material appears. Please send a copy to the Communications Department at the address below.

International Potato Center
Apartado 558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

Produced by International Potato Center

Citation:
De Haan, S., Salas E., Fonseca C., Gastelo M., Amaya N., Bastos C., Hualla V., Bonierbale M., 2019. Participatory Varietal Selection of Potato Using the Mother & Baby Trial Design: A Gender-responsive Trainer’s Guide. Lima: Peru. International Potato Center. ISBN: 978-92-9060-538-6. 81pp.

Cover image: The different phases of the annual cycle of participatory selection are illustrated, from the planning with farmers to the evaluation with value chain actors.

Illustrator: Josue Sanchez Cerron, a painter and plastic artist from Huancayo, Peru.

Design and layout: Communications Department
Press run: 500
May 2019

Printed by Comercial Gráfica Sucre S.R.L.: Av. Bausate y Meza 131, Interior 116, La Victoria, Lima-Perú

CIP thanks all donors and organizations that globally support its work through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders

This publication is copyrighted by the International Potato Center (CIP). It is licensed for use under the Creative Commons Attribution 4.0 International License
Participatory Varietal Selection of Potato
Using the Mother & Baby Trial Design:
A Gender-responsive Trainer’s Guide
8. ANNEXES

Annex 1. Minimal trial information 63
Annex 2. Trial installation 64
Annex 3. Material list 65
Annex 4. Crop management 66
Annex 5. Form F1: Selection criteria (flowering, harvest and postharvest stage) 67
Annex 6. Form F2: Selection of clones at flowering stage 67
Annex 7. Form F4: Standard evaluation of yield (mother trial) 68
Annex 8. Form F5: Standard evaluation of yield (baby trial) 69
Annex 9. Form F3: Ranking of the clones at harvest stage 70
Annex 10. Forms F6 and F7: Organoleptic evaluation 70
Annex 11. Form F8: Assessment of dormancy and sprouting behavior 71
Annex 12. Form F9: Ranking of the clones in storage 72
Annex 13. Sprouting pattern evaluation 72
Appendix 14. Photographic record 73
Acknowledgments

The authors thank the following donors for their contributions toward the implementation of the methodology and/or publication of this document: Government of Spain (the Spanish National Institute for Agricultural and Food Research and Technology); FONTAGRO (Red Latin Papa Breeders’ Network); Technical Cooperation Department of CGIAR Peru (the Decentralized Breeding Platform); Austrian Development Agency; the European Union (EU)-supported IssAndes project; United States Agency for International Development; Regional Program for Research and Innovation by Agricultural Value Chains–PRIICA (EU/IICA); and the CGIAR Research Program of Roots, Tubers and Bananas. We also acknowledge the valuable feedback and contributions from farmers, partner institutions, and individual researchers.

- **Instituto Nacional de Innovación Agraria** [National Institute of Agricultural Innovation] Lima, Peru: Dr. Noemi Zuniga, Eng. Hector Cabrera, Eng. Jesus Arcos, and Eng. Miguel Angel Pacheco
- **Grupo Yanapai** [Yanapai Group] Junín, Peru: Dr. Maria Scurrah, Eng. Edgar Olivera, Eng. Raul Ccanto, and Eng. Anali Janampa
- **Fundacion HoPe** [HoPe Foundation] Cusco, Peru: Mr. Walter Meekes
- **Asociación Pataz** [Pataz Association] La Libertad, Peru: Eng. Juan Miguel Perez, Eng. Henry Sanchez, and Eng. Ronal Otiniano
- **Universidad Nacional de Colombia** [National University of Colombia]: Dr. Carlos Nustez, associate professor of the School of Agricultural Sciences, Bogota Campus, Bogota, Columbia
- **Fundacion PROINPA** [PROINPA Foundation] Cochabamba, Bolivia: Dr. Julio Gabriel
- **Corporacion Colombiana de Investigacion Agropecuaria** [Colombian Corporation of Agricultural Research] Tibaitata, Colombia: Dr. Ivan Valbuena
- **Department of Agriculture, Ministry of Agriculture and Forests**, Timbu, Bhutan: Pema Wangchuk and Tshering Dochen
- **Secretaria Ejecutiva del Consejo Agropecuario Centroamericano, del Sistema de Integración Centroamericana** [Executive Secretariat of the Central American Agricultural Council, Central American Integration System]: Dr. Nadya Blanco (gender specialist)
- **International Potato Center**: Lima, Peru: Eng. Sonia Allauca, Dr. Anne Forbes, Eng. Felipe de Mendiburu (statistician), Dr. Netsay Mudege (gender specialist), Eng. Ricardo Orrego, and Eng. Raul Eyzaguire (statistician)
- **Instituto Nacional de Investigaciones Agropecuarias** [National Institute of Agricultural Research], Santa Catalina, Ecuador
- **Universidad para el Desarrollo Andino** [University for the Andean Development], Huancavelica, Peru
- **Escuelas Bilingues Interculturales de Tiracancha y Patacancha** [Tiracancha and Patacancha Intercultural Bilingual Schools], Cusco, Peru
- **Bangladesh Agricultural Research Institute**, Dhaka, Bangladesh
- **Regional Program for Research and Innovation by Agricultural Value Chains, IICA**: Eng. Allan Menezes, MSc (specialist in agricultural technological research and innovation)
Introduction
Globally, the last two decades have been notable for the increased integration of participatory evaluation methods into technology development and crop improvement programs. Using participatory varietal selection (PVS) farmers, as intermediate or end-users of the technology, are engaged early on in evaluating a diversity of advanced clones or candidate varieties from breeding programs. The involvement of farmers, consumers, private sector, and other stakeholders in PVS is essential because it enriches the selection process by taking into account preferences, perspectives, and multiple selection criteria in environments with different contexts and socioeconomic backgrounds (Quisumbing and Pandolfelli 2009). Through participation, farmers and other stakeholders gain more knowledge about new candidate varieties, which facilitates earlier adoption through improved access to best-bet clones (Klawitter et al. 2009). An example of this is the experience of adoption of new potato varieties, such as ‘Puca Lliclla’, ‘Pallay Poncho’ and ‘Serranita’ in Peru and ‘Nasephey Kewa Kaap’ in Bhutan, where these varieties are now successfully being marketed (CIP 2012; Wanchuk et al. 2015). Furthermore, the International Potato Center (CIP) uses information from PVS to obtain systematic feedback for each improvement program and development of advanced clones based on previous end-user information.

Since 2003 CIP has applied an adapted, the PVS methodology using the Mother & Baby Trial (MBT) design. This effort has been possible through both the strategic support of diverse donor-funded projects and through strategic alliances with government institutions, grassroots and civil society organizations, and universities. PVS encourages the active participation of farmers through the application of treatments in their own plots (i.e., “Baby” trials) and in fields with an experimental design (“Mother” trials managed by the technical team), as well as through systematic evaluations and selections of treatments. The farmer-managed Baby trials are valuable for assessing the performance of advanced clones under farmers’ conditions and for disseminating new candidate varieties. It builds on the notion that the advanced clones standard farmer practice, rather than requiring an optimal management package that smallholder farmers may not be able to afford. The researcher-recommended Mother trials, on the other hand, generally include technical recommendations provided by the researchers on components such as planting distance, fertilization, or integrated crop management.

The evaluation strategy underlying the MBT design also gives people a voice, recognizing that both men and women have valuable but different experiences, preferences, and knowledge. Capturing the findings from the point of view of both men and women is very important, given that potato production often involves gender-specific roles; thus, they might have different criteria when selecting a new potato variety. Therefore, through the practical steps described in this guide, the PVS methodology can complement the standard evaluation procedures required for the formal release of potato varieties.

---

1 Hereafter, the term “farmers” will refer both to men and women farmers.
2 That is, an advanced or elite clone that the breeder or institution considers must undergo official performance tests locally in order to obtain a Release Certificate.
The term “sex-disaggregation data” is defined as any data that have been disaggregated by biological sex and thus present information specific to the life experiences of males and females.

The PVS methodology using the MBT design was originally developed by researchers based on participatory action research within a soil fertility network in southern Africa (Snapp 1999). It has been used—and modified—by numerous research centers, including CIP, the International Institute for Tropical Agriculture, the International Rice Research Institute, and the International Maize and Wheat Improvement Center (Badu-Apraku et al. 2012; Witcombe et al. 1998). The methodology was first adopted and adapted by CIP for PVS in Peru through decentralized evaluation networks and multi-year evaluations in potato-growing areas in the Andean region (including Cusco, Huancavelica, Lima, La Libertad, and Junín), where a team of researchers and extension staff systematically interacted with interested stakeholders. Smallholder farmers in the Andean highlands where PVS was promoted had limited financial resources, high rates of food insecurity, and limited access to new technologies. From 2008 to 2013, the PVS network in Peru alone involved an average of 450–1,100 farmers per year in the assessment of candidate varieties in more than 55 remote communities. It resulted in the release of at least five varieties for diverse socioeconomic contexts. The methodology initially had to be adapted to potato because of the crop’s low multiplication rate which, in turn, influences the size and number of trials that can be conducted with new clones. At that time several methods were used; but in order to promote integration and make it possible to perform spatial and time-line series data comparison, a single semi-standardized methodology was developed. Over 5 years, staff from nongovernmental organizations (NGOs) and national agricultural research institutes gathered each year in workshops to improve the different steps of the methodology and facilitation techniques.

This gender-responsive trainer’s guide builds on previous (unpublished) user guides that have been developed and validated in Latin America (Fonseca et al. 2010) and Asia (Wangchuk et al. 2015). It is the result of a compilation of facilitator feedback and a thorough revision by gender experts. It is well recognized that men and women may have differential access to resources or provide different end-uses to crop varieties; therefore, their needs may also sometimes differ. In this respect, it is essential to have a technology that meets the needs of both men and women, or alternatively, to provide multiple options that cover the demands of both genders. The collection of sex-disaggregated data and active participation of both men and women during PVS increase the chances of successful variety release. A gender-sensitive PVS process recognizes that “while it may be difficult to combine all preferred traits into one unique variety because of genetic constraints, it is important that both men and women have a basket of choices of candidate varieties suited to multiple needs and agro-systems” (Paris et al. 2001). Indeed, breeders and variety release committees increasingly recognize that the model of a “single widely adapted super variety” is often incompatible with the real needs of smallholder farmers depending on climate, use, seasonality, and the like. In crop management no “single size fits all.”

---

3 The term “sex-disaggregation data” is defined as any data that have been disaggregated by biological sex and thus present information specific to the life experiences of males and females.
Objectives

This guide aims to provide step-by-step guidance on facilitating and documenting the PVS dynamics using the MBT design to select, and eventually release, potato varieties preferred by end-users that suit male and female farmers’ different needs, diverse agro-systems, and management practices, as well as traders’ and consumers’ preferences.

Specifically, this guide aims to:

• Provide a common, semi-standardized methodological framework to institutions and trainers/facilitators involved in the PVS of potato and/or other root and tuber crops

• Explain and describe in detail the steps involved in systematically capturing desired traits (i.e., attributes and preferences) that farmers and other end-users look for in new potato varieties

• Offer tools to identify and understand consumer preferences

• Provide a field-book-based data management system to systematically register and analyze data captured through PVS

Who should use this guide?

• Breeders or researchers working on varietal selection with smallholder farmers in heterogeneous environments

• Trainers and facilitators coordinating groups or networks involved in PVS

• Development workers, field technicians, and extension workers aiming to improve rural livelihoods through the introduction of new candidate varieties

How to use this guide

This guide provides tools to evaluate and select, new potato candidate varieties using the MBT design. To achieve this, a set of experiments and evaluations should be carried out to meet specific objectives. Three participatory evaluations are proposed to identify the preferred traits that female and male farmers have regarding the vegetative development, production, and postharvest stages of the potato crop.

After the introduction, this guide is organized into six technical sections (all the specific steps and tips you need to perform the evaluations will be found here). These sections comprise the following:

• Section 1 presents a step-by-step guide on how to conduct PVS using the MBT design. It discusses five topics:

  1. Planning of the MBTs
  2. Capacity building
  3. Trial characterization
  4. General considerations on PVS
  5. Workshops for exchanging results and planning

• Sections 2–4 explain how to conduct evaluations at the time of flowering, harvest, and postharvest, respectively. Each of these sections provides detailed steps involved in carrying out the specific types of evaluations.

• Section 5 discusses the statistical analysis of the experimental data. If evaluations from different environments are going to be compared, we suggest that you use standardized methods when gathering and analyzing data. The way additional information is collected, however, is left completely up to the discretion of the researchers.

• Sections 6 and 7 present the list of acronyms and references cited in this guide, respectively.

• The guide concludes with 14 annexes (Annexes 5–12 are forms to be used to conduct PVS using the MBT design).

What are MBTs?

MBTs are participatory research designs that allow researchers, development workers, and facilitators to test advanced clones or best-bet new technologies through two types of trials:


1. **Mother trials.** A Mother trial is developed within the study area (experimental field station or farmers’ field), following a randomized complete block design (RCBD), and is managed by a researcher or agricultural technician. Each Mother for PVS trial has at least three replications on plots with at least 40 plants (>10.8 m²). Mother trials involve the testing of advanced clones or candidate varieties and control varieties (or checks) under optimal management as recommended by researchers or extensionists (e.g., Other best practices to be demonstrated).

Involving farmers in researcher-managed trials eliminates “the possibility of putting forward genotypes for official variety release that are not accepted by farmers” (Grüneberg et al. 2009). We generally recommend installing Mother trials on farmers’ fields for demonstration purposes so that they can easily be compared with the Baby trials in the same geographical area. Mother trials are different from Baby trials (see below) because they (1) have multiple replicates, (2) are managed by a technician, (3) include an agronomic management package that accompanies the clones under selection, and (4) in some cases can be installed on research stations. The underlying assumption is that clones show their true genetic potential under optimal crop management conditions which will be presented to all participants during visits to the mother trial.

2. **Baby trials.** These are individual trials in farmers’ fields located near the Mother trial. They allow for assessment of variations under farmer management and the environment they face but are monitored by researchers. Every Baby trial is a trial that contains the same group of clones used in the Mother trial and should be established in three or more farmers’ fields (Fig. 1). Baby trials are different from Mother trials because they generally consist of a single replicate and are managed largely by the farmers themselves. The underlying assumption is that clones that perform well under farmers’ management conditions are more likely to become a varieties that is acceptable, adopted, and easily spread. If enough planting material is available and farmer field size allows, replicated trials can be considered. In situations with extremely fragmented smallholder land-owning (e.g., fields smaller than 100 m²), it may be necessary to use incomplete replicates and divide smaller panels of clones among more farmers.

Both mother and baby trial are developed in parallel in the same growing season and within the same agro-ecological zone during the PVS process. It is important to maintain one or two constant control varieties or checks in all trials. The researcher can use data from both the Mother trial and the Baby trial and thereby obtain information on the suitability of advanced clones for different agro-ecologies and different management and/or socioeconomic conditions of farmers. Seed multiplication and marketing can be guided through this system if seed selection is practiced on-farm and value chain actors are involved in the qualitative evaluations. Farmers hosting trials on their fields should be duly compensated (e.g., by paying them to rent their fields and/or greater access to seed of preferred clones).

---

**Figure 1. MBT design to evaluate advanced potato clone varieties through PVS.**

| DETAIL            | MOTHER                        | BABY                         |
|-------------------|-------------------------------|------------------------------|
| Design            | RCBD                          | Simple                       |
| # of replications | ≥ 3                           | ≥ 1                          |
| # of trials       | ≥ 1                           | ≥ 3                          |
| Management        | Researcher                    | Farmer                       |
| Evaluation        | Perceptions of researchers,   |                              |
|                   | farmers, and other end-users  |                              |
| Treatments        | Complete                      | Complete                     |
|                   | (all clones)                  | (all clones)                 |
| Control           | ≥ 1 or 2 local varieties      |                              |
What is the chronological order of conducting PVS, and how long does it usually take?

The time necessary to conduct PVS using the MBT design depends on the context. Assuming that everything goes well, this methodology can be conducted and completed in three clonal selection years or three growing seasons. This saves time and can result in quick releases compared with conventional procedures. As Figure 2 shows, the first selection year ideally starts with 20–30 advanced clones (including checks) covering a minimum area of 10.8 m² per clone and per replication (216–324 m² per full replication, excluding paths or borders). The advantage of starting with this number of clones is that farmers and other end-users have sufficient diversity to select from.

Applying this technology, the number of advanced clones is gradually reduced throughout the cycles until only the top two to five candidate varieties in the third year remain. Normally, the number of MBTs and the plot size per replication increase, and the number of unique clones under selection decreases. Under optimum conditions, and with the right institutional support, the selection of a new variety to be proposed for release takes only 3 years. Yet experience teaches that it sometimes takes longer because of various factors such as (1) initial seed stock, (2) the need to repeat one or more years after an abnormal season, (3) difficulty of farmer groups to discard some clones, and (4) the need to conduct more trials as required according to the formal national variety release procedures. In fact, such procedures can sometimes delay the official release of new varieties coming out of PVS.

Researchers can use the results from PVS to:

- Obtain systematic feedback that can be incorporated into the breeding program based on key traits, features, and preferences desired by end-users
- Improve the distribution of genetic material based on end-user assessment
- Gain efficiency in the breeding process by increasing the likelihood of end-user adoption and diffusion, thereby reducing the time required for variety release

Important points to consider before conducting PVS using the MBT design

- The success of applying this methodology in PVS depends largely on the research team’s skills involved and appropriate facilitation. The local coordinator or facilitator needs to be able to convey information using informal language and make the exercises as fun and informative as possible.
- The preconditions to apply this methodology include:
  - Evident local demand for new varieties
  - Availability of seed tubers of diverse advanced clones
  - Commitment of researchers, farmers, development partners, and other stakeholders to work in partnerships during multiple cropping seasons
The end-use of the new potato varieties determines the likely success of PVS. If home consumption is the predominant end-use, involving farmer households alone may be sufficient. If potatoes are predominantly marketed, however, it is essential that traders, processors, and/or consumers be involved.

Among the social, cultural, and economic factors that determine the adoption of candidate varieties are their likely fit to different end-users, farmers’ socioeconomic status, and gender-specific roles. Community empowerment and the importance of involving women are central to the PVS concept and protocol (Paris et al. 2006). Be sure that facilitators are willing to make an effort to involve both men and women during the whole selection cycle and to collect gender-disaggregated data. An enabling environment for women participation should be created (e.g., provide transport, serve a meal during field days, and involve female facilitators and leaders).

What does it cost to carry out this methodology?

The cost will depend on the site and context where the research takes place. Some important items that you should take into account when estimating the budget are (1) land rent (compensation), (2) transportation costs, (3) material needed for the different evaluations (e.g., flipcharts, markers, tape, cardboards, etc.), (4) labor costs (planting/harvesting), and (5) refreshments for the participants during the evaluations. Keep in mind that when women attend training events or trial evaluations they often bring their children. This needs to be considered and planned for when estimating the quantity and cost of refreshments. Costs tend to go up over time as the number of trials, sites, and plot sizes increase.

For action research with poor communities, it is important to compensate farmers for the land, labor, and other investments. Mobilizing women to the trial evaluation may generate an additional cost that needs to be taken into account; however, these costs can be drastically reduced if organizations that have soft skills related to mobilizing communities and women are included in the partnership when the PVS program is designed. When working with multistakeholder consortia involving different public or private institutions or consortia in different regions, it will be important to host at least one seasonal face-to-face workshop to discuss the results and plan the following season or year (see Section 1.5).

What are the likely logistical challenges?

- Location of the study areas (some might be quite far away or inaccessible)
- Availability and commitment of the team to work in remote areas
- Communication between communities where trials are taking place and the partner institutions
- Having equal participation of men and women farmers; for this purpose it is important to inform the participants that basic facilities will be provided (e.g., transport, meals, etc.)
- Involving a translator who can explain the methodology using a language that is common or native to the intervention area
- Ensuring participation of a core group of farmer participants between cropping seasons and stages of selection

General recommendations

- Make sure that the initiation of PVS is demand-driven and based on genuine interest of the farmers and stakeholders to select a new variety for their conditions and requirements. The lack of grassroots interest is a recipe for failure.
- Encourage working in interdisciplinary teams, including breeders, gender experts, economists, and extension workers. It is important to include female scientists or extension workers in the research team as it facilitates women’s participation, especially in a conservative context (Leduc 2009).
• Good facilitation is the key to success in any participatory research activity. Make sure that explanations are didactic and clear, exercises do not take too long, there is a team supporting the effort, and that the process overall is useful and fun for participants.

• Ideally, select female and male farmers in all socioeconomic groups and involve civil society, private sector, and all other relevant stakeholders of the production chain.

• Determine modes of participation that ensure equitable compensation for participating farmers.

• Always share results with all stakeholders, preferably after evaluations of field trials. This will ensure that people’s participation is valued and interactive.

• Be aware of cultural and institutional constraints and logistical problems that can affect farmer or equitable gender involvement in participatory varietal research activities.

• Never assume that new varieties are user-neutral, and that farmers (both men and women) can achieve the same type of benefit from new varieties (Paris et al. 2006).

• After each agricultural year, discuss the overall results from all trials with selected stakeholders, in order to discuss which clones will continue to be evaluated next season or proposed for release.

• Use the methods recommended in this guide and in managing data consistently. This is particularly important for the principal investigator or overall coordinator, because the information will be needed as soon as varieties are proposed for release, and a technical proposal for official release has to be developed.

• If a baseline survey is conducted, it should include questions to allow sex-disaggregated information to be gathered. Moreover, a good baseline study can help to obtain a priori information on factors determining farmers’ varietal choice from households and individuals who may not participate in the MBTs.
Conducting PVS using the MBT design: a step-by-step guide
This section provides an overview of the MBT methodology and the five stages involved in its implementation: (1) planning of the trials, (2) training of partners, (3) trial characterization, (4) general considerations for PVS, and (5) results exchange and planning workshop.

### 1.1 Planning the MBTs

Careful planning of the MBTs is critical to their successful implementation. We discuss three key activities that are related to planning:

1. **Identification of partners or research collaborators to form a consortium or agricultural innovation groups**. These should be interested in PVS and consider the evaluation of potential new advanced varieties to be important. Consortia may include public and private institutions, research and/or agricultural extension institutes, NGOs, local municipalities, producer groups, universities, and other institutions working in potato-growing areas. Because one of the local partners supervises the MBTs, it is important that consortia members and the breeding program providing the germplasm reach consensus on the objectives of PVS and treatments of the trials. Working with local grassroots partners guarantees good integration into communities and makes the implementation of this methodology effective. Local-level partnerships and civil society organizations that have experience mobilizing men and women should be considered as partners even if they may not have technical expertise.

2. **Identification of research sites.** Choose the sites where the MBTs will be established based on the importance given to potato production in those regions. These sites should ideally be within the scope of the partner institutions. Another critical consideration is the farmers themselves and their needs within their agro-ecological, socio-cultural, and economic environment. PVS should be demand-driven; it should ultimately be the farmers and local communities themselves that have an interest in selecting new varieties. To encourage women’s participation at this stage, some of the researcher-managed fields must be located close to farmer communities where they are easily accessible for local participants to attend field days.

3. **Coordination and clarity on responsibilities.** The role of different stakeholders should be clear, with specific institutions taking care of data management, coordination of field days, mobilization of farmers, and other matters. At least one organization (or person) should maintain the overall overview, since the whole process from set-up to variety release can take 3–4 years.

### 1.2 Capacity building

Adequate training will allow coordinating institutions and professionals to acquire the skills needed to plan, install, conduct, assess, collect, and process the data from the MBTs. This trainer’s guide can be used to support the training. Ideally, training is offered centrally, bringing together people (women and men) from different consortia and locations. Preferably, capacity building should include practical training for field evaluations as well as for statistical analysis of the results. Training sessions can be structured into different modules, including (1) planning, (2) execution, (3) facilitation, (4) gender considerations, and (5) statistical analysis and data management. The different modules are not necessarily for the same target group. Therefore it is important to tailor the training to the specific group: technicians, facilitators, data manager, or mixed trainees.

---

4 Group of public and private actors with a common purpose and located in a nearby geographical area for the joint work in the identification of the best-bet potato variety.
In communities where researchers and extension agents have difficulty recruiting sufficient numbers of women, careful consideration needs to be given during partnership and/or consortium building. For instance, researchers may identify local women’s organizations or women leaders in the community who can help them to mobilize women to participate. You may also need to work with NGOs are experienced in gender-sensitive community mobilization methods to ensure that both men and women participate.

Three key considerations are to:

- Involve people with grounded experience in the training. Equipping facilitators with skills and tips on how to facilitate the different exercises and to actively engage farmers is key. Peer-to-peer exchange of tips among experienced facilitators and colleagues can be very enriching.

- Combine theory and practice. Make the training fun and ensure that there is opportunity to actually practice the different exercises—from evaluation at the vegetative stage to postharvest—so that real situations are simulated.

- Learn by doing. This can be stimulated by having experienced facilitators participate in field trials during the first season of new MBTs, so that local staff can benefit from experience during subsequent seasons. Also, cross-consortia and cross-site visits will enrich practice-based learning.

**Table 1. Overview of trial characterization registration forms used in MBTs**

| Form                      | Annex |
|---------------------------|-------|
| Minimal trial information | 1     |
| Trial installation        | 2     |
| Material list             | 3     |
| Crop management           | 4     |

**1.3 Trial characterization**

Between the period of planting and harvesting of the MBTs, basic data should be collected in each of the trial localities. Minimal basic field data of MBTs will be collected for the experimental plots and for crop management, including the use of fertilizers, weed control, pest and disease control, and/or other practices. Optionally, data on soil and climate characteristics of the plots where the MBTs are located should be collected. Table 1 lists the necessary forms to register field data and the related annexes where you can review their content.

**1.4 General considerations of PVS**

There are three primary objectives of PVS:

1. To stimulate early exposure of smallholder farmers in diverse agro-ecologies and other key actors to advanced breeding materials; thereby promoting the decentralized selection of adapted and preferred candidate varieties. Experience shows that this will enhance early adoption and increase the likelihood of impact.

2. To systematically identify the preference traits that female and male farmers have regarding the flowering, harvesting, and postharvesting
stages; thereby enhancing the intelligence of breeding programs, either for the tailored deployment of advanced clones or the formulation of complementary breeding objectives.

3. To foment continuous interaction between breeders, farmers, development agents, value chain actors, and other gender specialist, stakeholders in order to connect supply and demand in the variety development process.

At the heart of PVS are the female and male farmers from the rural communities where the MBTs are implemented. Their perceptions are influenced by cultural background, gender norms, markets, and other drivers operating in the socioeconomic context where they live. Depending on the actual location where PVS is practiced, there will likely be a range of other actors who want to participate in the selection process, including municipal authorities, traders, and NGOs, among other stakeholders.

PVS includes three evaluations (Fig. 3). The first evaluation occurs at the flowering stage, ideally when about half of the potato clones are either in full bloom and/or at the stage of investing energy in tuber bulking. The second occurs when the potato reaches maturity and the crop is ready to be harvested (harvest stage). The third is optional and involves the evaluation of storage characteristics (postharvest stage). This evaluation is implemented at 45 and 90 days after harvest (DAH), ideally in the second or third year of the overall selection process when the number of clones under evaluation has been reduced to those that are the most preferred (even though evaluation is optional, we strongly recommend it for contexts in which storage is an issue). PVS must have a balanced or equal representation of men and women in the varietal selection and evaluations at all three stages, making it possible to conduct sex-disaggregated analysis to identify men’s and women’s needs and preferences.

To systematically evaluate and select the best clones or candidate varieties at each stage, a series of qualitative assessments are conducted by female and male farmers. Simultaneously, quantitative performance evaluations concerning agronomic, yield, and storage characteristics are performed by the facilitating research team (technicians). The type of information collected at each stage, at the plot level for the MBTs, as well as the general methods used are outlined in Table 2. The details of each evaluation are explained in the following sections.

These evaluations are commonly facilitated by extension agents, technicians, and/or researchers who, in addition to having agricultural knowledge about the crop, need to have soft skills that will enable them to guide the process in an inclusive and gender-sensitive way.

The PVS facilitators ideally need to:

- Ensure that both men and women have the opportunity to participate when the MBTs are evaluated. This will be a critical element to think through in advance, especially in communities where women may normally not be invited, women may feel inhibited in the presence of men, or it is simply not accepted for men and women to mix.

- Ensure farmer participation from all socioeconomic groups and representative of the target

TIP!

We recommend that men and women of different ages participate, given that potato production involves gender-specific roles and may imply different criteria when selecting new varieties. Involving female and male leaders will help to stimulate overall participation.
Figure 3. Growth stages of the potato and the three main stages of evaluation of PVS.

Table 2. Components and methods used at each evaluation stage

| Component                        | Method               | Evaluation Phase |
|----------------------------------|----------------------|------------------|
| Collection of selection criteria | Free-listing         | Flowering  X     |
|                                  |                      | Harvest X        |
|                                  |                      | Postharvest X    |
| Prioritization of selection      | Weighted ranking     | Flowering X      |
| criteria                          |                      | Harvest X        |
|                                  |                      | Postharvest X    |
| Ranking of best clones           | Weighted ranking     | Flowering X      |
|                                  |                      | Harvest X        |
|                                  |                      | Postharvest X    |
| Standard evaluation (yield)      | Direct observation   | Flowering X      |
| Standard evaluation (storage)    |                      | Harvest X        |
| Organoleptic evaluation          |                      | Postharvest X    |
population in the region, district, or village. Although poor farmers may initially be more wary about trialing new technologies than better-off potato growers, this should not be an impediment to participating during the field days when clones are evaluated.

- Work with local partners to mobilize farmers’ and other stakeholders’ interest in new potato varieties. Local authorities, NGOs, agricultural schools, municipalities, cooperatives, traders, and input suppliers are some of the stakeholders to be considered. The process can benefit from working together with local partners that have experience in mobilizing women. This needs to be built into the partnership strategy for any consortium promoting PVS using the MBT design.

- Deploy a variety of adult learning and facilitation skills that keeps the participants interested and involved throughout the process (Years 1–3) and during the multiple evaluations conducted during field days (Chambers 2002; Pretty et al. 1995).
1.5 Results exchange and planning workshop

It is often very useful for the technical team and consortium members to have a results exchange and planning workshop to share the overall results and take decisions about the upcoming seasons or concrete steps needed to pursue variety release. Such workshops generally need to be held between the harvest and planting seasons. Once the field assessments and data analysis are completed (seasons 1, 2, and 3), the facilitators of the MBTs ideally share a report with the main findings and compare the results of each evaluation stage for the past season (vegetative development/flowering, harvest, and postharvest stages). For data to be useful for breeders and variety release authorities, a selection index needs to be discussed in order to prioritize clones for trials during the upcoming season or for official release. It is important that the results of each year are documented and stored in databases and that the dataset can be published in open access mode. It is also important that consensus be reached among the stakeholders involved regarding next steps, lessons learned (what worked and what didn’t), and, importantly, the clones to be rejected or promoted. Data will be analyzed and presented in a sex-disaggregated manner, thus exposing gender differences if these exist.

The report is ideally shared before the workshop and consolidates the main results of the last season. The workshop will bring together breeders, extension workers, facilitators, lead farmers, and gender specialist, other stakeholders interested in the process and progress.

The workshop is generally organized on a regular basis by the coordinating or lead organization of the PVS consortium. For instance, if there are 3 years of varietal selection assessments, there should also be three consolidation workshops

TIP!

Each facilitator has a different style, yet a few general recommendations are given below. Apply as suitable for your context:

1. Facilitate between several people (two or three facilitators). This makes the variety of styles, voices, and instructions more diverse and keeps people interested.
2. Make jokes and aim to make the whole selection process a fun experience. A fair dose of appropriate humor can put people at ease.
3. Use simple language and talk slowly. Ask people if they understood the instructions and involve others (with experience) in clarifying the exercises.
4. Value people and their ideas. Build on the feedback and suggestions received from the participants and be flexible to adapt where feasible.
5. Do not facilitate only the process, but also the product coming out of the evaluations. Always share the results with the group during the field days.
to take stock of results and plan next steps. **It is best if each workshop deals with the following questions:**

- Which are the clones to be discarded and which are the best performing or preferred clones to be taken forward to the next season?

- Which stakeholders participated during the last seasons? Are these representative and is there a need for additional actors to be invited?

- Has participation been up to expectations? What can be done to improve the process?

- Have the data been processed, stored, and made available for all consortium members?

- How many trials will be installed next season, and with which materials and design? Who are the communities and farmers interested in having the trials on their land?

- Have candidate varieties been identified, and is it appropriate to initiate seed production and the formulation of a (formal) variety release proposal?

If possible and appropriate, we recommend that you ensure the participation of value chain actors. Experience shows that involvement of variety release authorities from the outset can be beneficial to achieving formal release. For example, in Peru many PVS consortia do not necessarily conclude with the formal release of varieties because of strict regulations that seek nationally adapted rather than locally preferred or adapted (candidate) varieties. Whereas in Central American countries (e.g., Panama, Belize, and Dominican Republic), formal registration is only required in case the company and/or institution is interested in selling seeds.
2

Evaluation at flowering time (vegetative development)
2.1 Who participates in this evaluation?
The evaluation at the flowering stage is mainly performed by women and men farmers from the communities where the trials are installed. The main facilitator from the lead institution coordinates the different evaluation exercises, while other research consortium members are motivated to attend.

2.2 How is this evaluation performed?
This evaluation is conducted for each replication of the Mother trial (i.e., three replications = three evaluations) and for each Baby trial (three to four depending on the number of trials installed). The whole evaluation usually lasts on average 2–4 hours.

The evaluation is done in two main steps:
1. Gathering (free-listing) and ranking of selection criteria at the flowering stage
2. Ranking of preferred clones by plot: ranks the advanced clones and representative control varieties that farmers favor

Prior to starting the actual exercises, it is very important to explain and/or remind participants about the purpose of the gathering, the origin of the breeding clones under evaluation, and the program for the day’s PVS activities. It is equally important to finish the field day with a presentation of the results obtained. This can be done on a flipchart or just through a clear summary explanation.

2.3 What materials are needed for this evaluation?

- Cards or signs with 1–1.5 m sticks (20 x 30 cm) to identify the clones
- Flipcharts to provide basic explanations and list of results
- Seeds from two crops (e.g., corn and beans) to cast votes
- Containers (paper bag, small cardboard or plastic box) to deposit the seeds (ranking)
- Tape, markers, and loudspeaker for big groups
- F1 and F2 forms of the field book to register data (see Annexes 5 and 6)

Tip!
The evaluation of each Mother trial can be performed by a group of invited farmers and key stakeholders, ideally as a field day. The evaluation of each Baby trial, on the other hand, can often be conducted more easily by the families managing the Baby trials and their direct neighbors.
Tip!

Make sure the clones and control varieties are marked using anonymous identifiers (i.e., numbers) and that the bags and or trays for the next step are placed in the field before the participants arrive. This saves time and makes voting or ranking more efficient.

STEP 1: Gathering and ranking of selection criteria at the flowering stage

Gathering of selection criteria (free-listing)

1. The group of farmers (men and women) and other stakeholders are gathered and the overall objectives of the trial, the evaluation and STEP 1 are briefly explained. This step takes place before people actually go to the plots to evaluate the clones/varieties (i.e., STEP 2). Usually this happens beside the field, preferably with people in a circle or U-shape.

2. Ideally, do this exercise with a single mixed group if the context allows for open free-listing of both genders. However, in some societies or contexts, women may not feel comfortable contributing to public debate when men are present; they may provide inaccurate information, or agree with what men say even if they (women) may have a different opinion. If necessary, separate men and women so that you have two groups. Involve women facilitators and leaders to work with female farmers.

3. Then ask the following questions: What do you look for in a new variety of potato when the crop is at the flowering or vegetative stage? In other words, when do you say that a variety is good or bad, when evaluating at this stage?

4. Encourage the greatest number of possible answers, and compile a list of all the criteria mentioned by the different participants (i.e., free-listing). For example, resistance to late blight, enough foliage to feed livestock, compact plant habit, and plants show vigor. Each

Tip!

When working with a mixed group of male and female farmers, be ready to encourage women to speak, and to try to elicit both men’s and women’s views. Depending on the context, think upfront about options (e.g., address yourself directly to specific groups or individuals, or involve farmer leaders to encourage participants, among other options).
Tip!

It is important to get participants to be precise. Only specific traits or characteristics should be put on the flipchart and paper bags. If the criterion is not clear, the facilitator should ask the participant to be more specific (see examples in Table 3).

Table 3. Examples of the level of clarity desired when free-listing

| Characteristics or Traits | Facilitators Counter Question to Elicit Precision | Desired Precision       |
|---------------------------|--------------------------------------------------|-------------------------|
| Plant architecture        | What do you mean by plant architecture?           | Erect plant habit       |
| Disease resistance        | Resistance to which disease(s)?                  | Late blight resistance  |
| Pest resistance           | Resistance to which pest(s)?                     | White fly resistance    |
| Stem color                | What color exactly?                              | Dark green stem         |

Prioritization of selection criteria (weighted ranking)

1. To select the most important traits for farmers we conduct a voting (or ranking) process. Thus, each of the mentioned criteria or traits is written on a paper bag or on a cardboard tray. Consequently, if the farmers have identified 10 criteria, we should also have 10 paper bags or cardboard trays.

2. Ask farmers to select the three criteria that each considers the most important. Thus, they need to vote for each criterion as they would vote during presidential elections, having three choices in this case.

3. To proceed with the ranking or voting process, six seeds are given to each participant. In order

Tip!

The facilitator can arrange the vote-casting in such a way that men and women do not influence each other’s vote (e.g., women can go before men since it is not likely that women will negotiate with men what criteria they should vote for). It has been observed that if men cast their vote first or at the same time, they may try to influence women’s vote.
Tip!

If farmers are illiterate, the facilitators should read them the traits so that they know what they are voting for. A creative alternative that has been used by some practitioners is to organize the voting as a market. Each bag or container is held by a person who promotes its text by speaking out loud while participants perform the ranking (see Picture 1).

to differentiate men’s and women’s votes, they are given different seeds (e.g., maize for men and beans for women). Facilitators need to be creative: other options for ranking can be identified, as long as it is possible to distinguish between men’s and women’s votes (e.g., blue and green beads).

4. The paper bags, trays, or containers are put in a line so that farmers can cast their vote by depositing the seeds, considering the following guidelines:

- Three seeds for the most important trait or characteristic.

- Two seeds for the second most important trait or characteristic.

- One seed for the third most important trait or characteristic.

5. The facilitators should show the participants how to cast their votes when choosing the three most important traits according to their individual preferences (Picture 1). It is also essential that the facilitator remind the participants that they need to observe all the criteria before voting, and that they should vote one at a time.

Processing and discussing the results

1. The final list and scores should be written down on a flipchart where Table 4 can be drawn in advance. This type of flipchart or summary report

Picture 1. Female farmers cast their votes into the paper bags (ranking) while (in this case) the men call out the text (characteristics or traits).
Table 4. Example of Form F1: Possible final result of the ranking process for selection criteria
(This form can be used to gather farmers' preferences at the flowering, harvest, and postharvest stages)

| Identified criteria          | Men  | Women | Global |
|-----------------------------|------|-------|--------|
|                             | N° of Seeds | Order of Importance | N° of Seeds | Order of Importance | N° of Seeds | Order of Importance |
| 1. Late blight resistance   | 14   | I     | 9      | II    | 23   | I     |
| 2. Abundant foliage         | 3    | IV    | 2      | IV    | 5    | III   |
| 3. Erect plant              | 1    | VI    | 11     | I     | 12   | II    |
| 4. Moth resistance          | 2    | V     | 2      | IV    | 4    | IV    |
| 5. White flowers            | 6    | II    | 6      | III   | 12   | II    |
| 6. Vigor                    | 4    | III   | 0      | V     | 4    | IV    |
| Total                       | 30   |       | 30     |       | 60   |       |

N° of seeds that men give to the trait
Order of importance of each feature with respect to the others

2. Once all farmers have voted, the votes (seeds) are counted and the results written down on the flipchart (see Table 4 for an example). The facilitator can generate a quick preference rating from the number of votes cast for the different traits or characteristics. The trait that has the most votes either for men or women will be ranked at the top, while the trait with the fewest votes will be ranked at the bottom.

3. The results from the voting process are shared with the participants to discuss them, to see if they have captured their preferences, and to find out why people preferred specific characteristics over others (Picture 2). For instance, Table 4 shows that “resistance to late blight” was considered to be the most important criteria for men; but for women “form erect of the plant” was slightly more important. In this case, having a brief open-ended discussion regarding why certain traits are preferred more by women/men can help participants to understand these differences and help the technicians or breeders understand what concern is behind each trait listed.

4. The results should be recorded on Form F1: Selection Criteria (Annex 5) by the technician for further analysis once all the evaluations have been conducted. This form captures the raw data from the Gathering and Ranking of Criteria from the Flowering Stage. These data will be sex-disaggregated and stored in the database.
Picture 2. Results from the voting process are shared with the participants.

**STEP 2:**

**Ranking of the preferred clones by plot at the flowering stage**

1. It is important that the clones and control varieties from the Mother trial (every replication) as well as the ones from the Baby trials are clearly identified with a number or a letter. The identifier can be written on a piece of cardboard. We recommend that a code or plot number be used for each clone or control variety instead of the genotype’s real name, to avoid preconceived opinions.

2. A container (paper bag, small cardboard or plastic box) is placed in front of each plot containing the different clones or candidate varieties. The container can be placed together with the cardboard or signpost with the identification code.

This is done for each clone, variety, and replication before the participants arrive.

3. The same farmers who participated in STEP 1 are gathered and the objective of STEP 2 is briefly explained to the group. It is now also possible for stakeholders other than farmers to participate—that is, technicians or traders.

4. Participants enter the field of the Mother and/or Baby trials to get an impression of the performance of the materials under evaluation. In the case of the Mother trial, each replication is observed. Participants observe the clones and control varieties with the request to identify their own personal favorites. Participants are reminded to keep the characteristics and traits from STEP 1 in mind.

5. As in STEP 1, six seeds are given to each farmer and seeds from different crops should be used to differentiate men’s and women’s votes. Explain to the participants that they cast their votes by depositing the in the containers. The exercise is repeated for every replication of the
To explain the use of seeds and the voting process for clones and control varieties, it is often useful to draw a parallel with a sports championship. The champion receives three grains, second place two grains, and third place one grain. This is easily understood in most contexts.

**Tip!**

To explain the use of seeds and the voting process for clones and control varieties, it is often useful to draw a parallel with a sports championship. The champion receives three grains, second place two grains, and third place one grain. This is easily understood in most contexts.

Mother trials (commonly three times). The following guidelines for the weighted ranking are provided:

- Three grains for the best clone
- Two grains for the second most preferred clone
- One grain for the third most preferred clone

6. Next, participants are encouraged to select the three materials (clones or control varieties) they consider to be the best at the flowering stage. In other words, the top three materials are to be identified by each participant individually and for each replication (Picture 3). Reiterate that votes are individual and that discussion is best reserved for the group meeting after voting. After this explanation, participants cast their votes.

Picture 3. Farmers voting for the top three clones or varieties they consider the best.
Voting for each replication of the Mother trial can take time, because three rounds of voting are usually required. With large groups of participants (>50), it is better to divide the group into three subgroups and have each one voting only once (each subgroup votes for a single replication).

7. Once all farmers have cast their votes for each replication (commonly three rounds of voting in a Mother trial), the facilitators gather the containers and count the number of seeds assigned to each clone/variety by men and women.

8. The facilitators then generate a summary of the results for feedback to the group (Table 5). The results are later also transferred to Form F2: Selection of Clones at Flowering Stage (Annex 6).

9. The results from the voting process are shared with the participants to discuss and reflect on why people preferred specific clones or control varieties over others. This is also an opportunity to pay attention to any gender differences that may occur.

Table 5. Example of Forms F2, F3, and F9 for summarizing the ranking clones (This form can be used to summarize farmers’ votes at the flowering, harvest, and postharvest stages)

| Community: ______________________ | Date: __________ | Trial: Mother [ ] Baby [ ] |
| Partner’s name: __________________ | No of Participants: ___ | No of Men: ___ | No of Women: ___ |
| Evaluation Stage: Flowering: [X] Harvest: [ ] Postharvest: [ ] |

| Control Clone / Variety | Rep | Men | Women | Total |
|-------------------------|-----|-----|-------|-------|
|                         |     | N° of Seeds | Order of Importance | N° of Seeds | Order of Importance | N° of Seeds | Order of Importance |
| 1.                      |     |             |                   |       |                   |       |                   |
| 2.                      |     |             |                   |       |                   |       |                   |
| 3.                      |     |             |                   |       |                   |       |                   |
| 4.                      |     |             |                   |       |                   |       |                   |
| 5.                      |     |             |                   |       |                   |       |                   |
| 6.                      |     |             |                   |       |                   |       |                   |
| Total                   |     |             |                   |       |                   |       |                   |
10. A brief wrap-up is held and participants are informed that the evaluation will continue during a field day at the time of harvest. Reiterate that everyone is welcome to participate at the next stage of evaluation. Emphasis can be placed on the fact that it is important for both men and women to participate.
Evaluation at the harvest
3.1 Who participates in this evaluation?

Evaluation at the harvest stage is mainly performed by farmers from the communities where the trials are installed. However, the harvest of the Mother trials during a field day offers a perfect opportunity to also invite variety-release authorities, traders, and other public or private sector stakeholders. This field day takes place one day before the evaluation of the Baby trial harvest. The facilitator from the lead institution coordinates the different evaluation exercises, while other research consortium members are motivated to attend. The standard evaluation of the harvest (STEP 1) is performed only by the technician and a small group of selected farmers. The organoleptic evaluation (STEP 4) can be performed with farmers immediately after the harvest or the next day, and with urban consumers in the weeks following the main harvest.

3.2 How is this evaluation performed?

Evaluation at the harvest stage involves more exercises than evaluation at the flowering and post-harvest stages. It is arguably the most important moment of evaluation. It is conducted for each replication of the Mother trial and separately for each Baby trial (three to four depending on the number of trials). Depending on the context, the whole evaluation of the Mother trial during a field day lasts 4–6 hours. This assessment comprises four steps:

1. Standard yield evaluation: To register measure of yield by clone and control variety.
2. Gathering (free-listing) and ranking of selection criteria: To gather the selection criteria and preference traits at the harvest stage.
3. Ranking of preferred clones by plot: To rank the advanced clones and representative control varieties that farmers favor.
4. Organoleptic evaluation: To evaluate the appearance, taste, and texture of boiled samples by clone and control variety.

Tip!

Make a field day of the evaluation of the Mother trial(s), inviting farmers and different stakeholders. In view of the time investment, it is important to provide a stimulus for participation (e.g., a shared meal and/or some seed of the best clones for farmers to take home.)
3.3 What materials are needed for this evaluation?

For the standard yield evaluation:
- Scale with a tripod for weight measurements
- Net bags, with capacity of 10–20 kg
- Nets or nylon or jute bags of 50-kg capacity to transport and store the harvest (ware and seed tubers)
- Markers, pencils, tape, paper, and labels
- Forms of Annexes 7–10 of the field books in printed format to register data

For the participatory selection:
- Cards or sign on a 1–1.5-m high stick (20 x 30 cm) to identify the clones
- Flipcharts to provide basic explanations and list of results
- Seeds from two crops (e.g., corn and beans) to cast votes
- Containers (paper bag, small cardboard or plastic box) to deposit the grains (ranking)
- Tape, markers, and loudspeaker for big groups
- Printed forms of Annexes 5 and 12 of the field book

For the organoleptic evaluation:
- Portable stove and pot to boil tuber samples
- Paper or plastic dishes to serve the tuber samples to the panelists
- Paper or plastic glasses to serve mineral water in between samples, or individual bottles
- Cards or signs to identify the clones and control varieties
- Printed form of Annex 6 of the field book

STEP 1: Standard yield evaluation (weight and number of tubers)

1. Since the Mother trials have at least three replications, we recommend that the harvest and the assessment of the yield are handled by the technician and a smaller group of farmers 1 day before the actual participatory evaluation with the whole farmers’ group (Picture 4). Consequently, the actual PVS during STEPs 2–4 can be done with less time pressure. Note, however, that it is important to communicate the quantitative results to the participants in the field day. As for the Baby trials, the harvest, the standard yield evaluation, and the participatory evaluation can usually be done on the same day.

2. The standard evaluation of yield consists of counting the number of plants harvested and the number of tubers harvested and measuring tuber weight. This evaluation is carried out for each clone and control variety under evaluation in the MBTs (including each replication).

3. First the number of plants harvested is recorded on Form F4: Standard Evaluation of Yield (Mother Trial) (Annex 7) in the case of Mother trials, and on Form F5: Standard Evaluation of Yield (Baby Trial) (Annex 8) for the Baby trials. Not all plants may have survived the season; therefore it is best to register the actual number of plants to be harvested for each treatment and replication.

4. Then, the tubers harvested are divided into two categories, “commercial” and “noncommercial,” depending on the size and quality that male or female farmers or traders consider appropriate for the market (Picture 5). In general, tubers are considered commercial if they are larger than 30 mm (or > 80 g); otherwise, they are considered noncommercial. This information is recorded in Annex 7 or 8 depending on whether the Mother trial or the Baby trial is being harvested.
The standard yield evaluation takes considerable time. We strongly recommend that the technicians harvest the trial 1 day before the actual field day and already have the quantitative yield (weight, number of tubers) registered. This saves a lot of time for the actual PVS. Piles of tubers by treatment and replication are left in the field. Results of the standard evaluation are shared during the field day.

Picture 4. Technicians and farmers harvesting potatoes 1 day before the field day. Tubers from each treatment and replication are put in piles.
5. Once the potato production by treatment and replication has been divided into two categories, the number of tubers is counted and their weight determined (Picture 6). This information is also recorded in Annex 7 or Annex 8.

6. To proceed with the organoleptic evaluation (STEP 4), we recommend at this point to put 1 kg of potatoes (i.e., approx. 10–15 tubers) from each clone or variety in the net bag with their respective codes or registration number. These will be boiled for taste testing: the same day for Baby trials and the next day for Mother trials.

7. Similarly, to be prepared for the postharvest evaluation, it is important to select a sample of 10 healthy commercial tubers from each clone/control variety per replication. Each sample is put in a net bag with its respective code or registration number written on a paper tag for easy

Tip!

If there are other local criteria that farmers take into account when selecting and grading production, then this can be taken into account. For example, some may prefer three categories: commercial ware size, seed tuber size, and noncommercial size.

Picture 5. Farmers selecting and grading potatoes by quality and size (commercial and noncommercial).
Tip!

It is important to carefully label the net bags containing the seed tubers to be used for the next cropping season. Labels can get wet, be eaten by rodents, or get lost. Always put one label on the bag and one inside the bag, specifying the identification code and number of seed tubers in each bag.

Identification. Every sample is weighed and the initial weight is recorded on Form F8: Assessment of Dormancy and Sprouting Behavior (Annex 11). All the samples are deposited in a typical storehouse belonging to farmers who have participated in the MBTs (see postharvest evaluation). The storehouse can be ware or seed potato store, depending on those postharvest characteristics that are the most in demand for the local context.

8. The tubers harvested from the Mother trial are left on the field overnight before being handled and stored. On the other hand, for the Baby trials the tubers can be handled and stored right after all the evaluations are concluded (STEPS 1–4). For experiments during the upcoming season, it is particularly important to carefully select and register seed tubers. All non-seed tubers can be sold or consumed.

**STEP 2: Gathering and ranking of selection criteria at the harvest stage**

This step follows the same exercises as described for the Gathering and ranking of selection criteria at the flowering stage. The only difference is that now the desired traits and characteristics of the harvest, particularly production, yield, and tuber-related preferences, will be dealt with.

Picture 6. The tubers of each treatment, replication, and category are weighed to determine yield.
Gathering of selection criteria (free-listing)

1. The group of farmers, men and women, and other stakeholders are gathered and the overall objectives of the field day, the evaluation, and STEP 2 are briefly explained. This step takes place before people actually go to the plots to evaluate the recently harvested clones and control varieties (i.e., STEP 3). Arranging the group in a circle or U-shape is ideal.

2. It is best to do this exercise with a single mixed group if the context allows for open free-listing of both genders. If necessary, separate men and women so that you will have two groups. Involve female facilitators and leaders to work with women farmers.

3. Next, ask the following questions: What do you look for in a new variety of potato when the crop is at harvesting stage? In other words, when do you say that a variety is good or bad when observing the production and tubers? Stress that at the harvest stage only the tuber characteristics should be taken into account (no foliage or growth-related features).

4. The greatest number of possible answers is encouraged and a list of all the criteria mentioned by the different participants (i.e., free-listing) is compiled (e.g., oblong tuber shape, shiny skin finish, high yield, shallow eyes, white-cream tuber skin, etc.). Each criterion is listed and written on a paper bag (or card with accompanying container) as well as on a flipchart (Picture 7).

Prioritization of selection criteria (weighted ranking)

1. To select the most important traits or production characteristics, a voting process is conducted with the participants. Thus, each of the mentioned criteria or traits is written on a paper bag or cardboard tray. Consequently, if the farmers...
have identified 12 criteria, you should also have 12 paper bags or cardboard trays.

2. Ask farmers to select the three criteria that each considers the most important. Thus, they need to vote for each criterion or trait as they would vote during the presidential elections of their country, having three choices in this case.

3. To proceed with the ranking process, six seeds are given to each participant. In order to differentiate men's and women's votes, they are given different seeds (e.g., maize for men and beans for women). Facilitators need to be creative: other options for ranking can be identified, as long as it is possible to distinguish between men's and women's votes (e.g., blue and green beads).

At harvest time, the field day may attract stakeholders other than farmers, such as traders, extension agents, and input suppliers, among others. These stakeholders can also participate and become part of the group.

4. The paper bags, trays, or containers are put in a line so that farmers can cast their vote by depositing the seeds, considering the following guidelines:

- Three seeds for the most important trait or characteristic
- Two seeds for the second most important trait or characteristic
- One seed for the third most important trait or characteristic

5. The facilitators should show the participants how to cast their votes when choosing the three most important traits according to their individual preferences. It is also essential that the facilitator remind the participants to observe all the criteria before voting, and that they should vote only once (Picture 8).

Processing and discussing the results

1. The final list and scores should be written down on a flipchart, where Form F1 can be drawn in advance to fill in the results (see also Table 4 in the flowering stage section).

2. Once all farmers have voted, the votes (seeds) are counted and the results written down on the flipchart (see Table 4 for an example). The facilitator can generate a quick preference rating from the number of votes cast for the different traits or characteristics. The trait that has the most votes either from men or women will be ranked as number 1, whereas the trait with the fewest votes will be ranked last.

3. The results from the voting process are shared with the participants to be discussed, to determine whether they have captured their pref-

Picture 8. Women cast their votes for the preferred clones.
ferences, and to find out why people preferred specific characteristics over others (Picture 9).

4. The results should be recorded on Form F1: Selection Criteria (Annex 5) by the technician for further analysis once all the evaluations have been conducted. This form collects the raw data to be stored in the database.

**STEP 3: Ranking of the best clones by plot at the harvest stage**

The exercises for the ranking of preferred clones at the harvest stage are basically identical to those conducted at the flowering stage. Frequently, the harvest attracts more participants, but big groups (of more than 50 people) at the harvest of the Mother trial can normally be accommodated by forming three or four subgroups to vote for and evaluate separately the three replications of the trial.

Before the voting process, the clones and control varieties from the Mother trial (every replication) as well as the ones from the Baby trials should be clearly marked by a signpost (e.g., piece of cardboard with the identification code). This can be done early in the morning before the invitees for the field day arrive.

Picture 9. Participants discuss results of the preference trait ranking before moving on to evaluate the harvest.
Remember to draw a parallel with a sports championship. The champion receives three grains, second place two grains, and third place one grain. This generally works well to explain the exercise easily.

Tip!

Harvest time can be a good moment either to identify households that may be interested in testing clones on their farm during the upcoming season (Mother or Baby trials), or to diffuse small amounts of seed tubers of the preferred candidate for dissemination.

1. A container (paper bag, small cardboard or plastic box) is placed in front of each plot containing the different clones or candidate varieties.

2. The same farmers who participated in STEP 2 are gathered and the objective of the exercise is briefly explained to the group. It is now also possible for stakeholders other than farmers to participate (i.e., technicians or traders). However, their votes should be clearly differentiated from the farmers’ votes (e.g., using a different type of kernel).

3. The participants enter the field of the Mother and/or Baby trials to get an impression of the performance of the materials under evaluation. In the case of the Mother trial, each replication is observed. Participants observe the clones and control varieties with the request to identify their own personal favorites (clones or control varieties). Participants are reminded to keep the characteristics and traits from STEP 2 in mind.

4. As in STEP 2, six seeds from different crops are given to each female and male farmer, respectively. Explain that participants can cast their votes by depositing the seeds in the containers. The following guidelines for the weighted ranking are provided:

   • Three grains for the best clone
   • Two grains for the second most preferred clone
   • One grain for the third most preferred clone

5. Next, participants are encouraged to select the top three materials (clones or control varieties) they consider to be the best at the harvest stage. Reiterate that votes are individual and that discussion is best reserved for the group meeting after voting. In a Mother trial, three rounds of voting are needed for small groups (fewer than 50 participants) or only one round if the group is big enough (more than 50 participants) to be subdivided into three smaller teams. Once all farmers have cast their votes (Picture 10), the facilitators gather the containers and count the
number of seeds assigned to each clone or control variety.

6. The facilitators then generate a summary of the results for feedback to the group (see Table 5 for an example). The results are later also transferred to Form F3: Ranking of the Clones at Harvest Stage (Annex 9).

7. The results from the voting process are shared with the participants to discuss and reflect on why people preferred specific clones or control varieties over others (Picture 11). This is also an opportunity to pay attention to any gender differences that may occur.

8. A brief wrap-up is held, and participants are informed that the evaluation will continue for postharvest characteristics (under storage conditions).
Preference traits in the local cuisine and how clones perform when it comes to their organoleptic properties will directly influence the adoption of a new potato variety. An organoleptic evaluation refers to testing properties that can be detected by the sense organs such as taste, texture, astringency (perceived in the mouth), and aroma (perceived in the nose). In this step we will focus only on the appearance, taste, and texture of the recently harvested clones and control varieties.

1. This evaluation takes place right after STEP 3, and samples of all clones and varieties should be boiled and presented on plates. Samples were already separated beforehand (see STEP 1). Each sample is identified with a code to duly recognize the clone or control variety. Ideally, use the same code or number used in the MBTs so that samples can be easily identified.

2. The evaluations take place with smaller groups (panels) and should ideally each be facilitated by a technician. Panels are made up of five to six participants, at least half of whom are women. Each panel is assigned a maximum of four to five clones or control varieties to evaluate. For example, if the trial consists of 20 materials, at least four mixed-gender panels are needed.

3. The three components of the organoleptic evaluation are explained to the panelists: appearance, taste, and texture:

   - **Appearance** refers to the visual aspect of the boiled potatoes: potatoes may turn gray or dark after they are boiled. The evaluation is performed before testing the potatoes; options: excellent or light (5), fair or moderately light (3), poor or dark (1).

   - **Taste** refers to the flavor that the panelists experience at the moment of savoring the samples; options: excellent flavor (5), fair (3), poor and/or bitter (1).

   - **Texture** refers to the dry matter and starch content and so-called mouth feel that the potato

---

**Tip!**

We recommend you conduct two sets of organoleptic evaluations, depending on the final use of a new variety: for local consumption and/or sales. A test with local consumers (i.e., farmers) will be conducted at harvest. Another test with urban consumers can be organized after the harvest as the PVS process gets closer to identifying candidate varieties for release.

---

**Tip!**

Panels (groups of people) should not evaluate more than five samples (clones), in order to ensure adequate quality. Between samples, participants rinse their mouths with water.
samples have; options: mealy or floury (5), intermediate (3), waxy or watery to the palate (1).

4. Furthermore, the basic rules are explained to prevent bias. First, panelists should test and evaluate samples one by one (avoiding mixing). Second, panelists do not talk or look for consensus among each other (scores are assigned individually). Third, each panelist receives a bottle of mineral water for rinsing their mouths between the sample evaluations.

5. Each panelist is given an evaluation form (see Forms F6 and F7: Organoleptic Evaluation, Annex 10), which should be printed in advance. On this form, farmers can record (mark with an X) their individual scores regarding the appearance, taste, and texture of each individual sample (Picture 12). If farmers are illiterate, the facilitator or support staff should help them to fill out the form or adjust the form with symbols, as shown in Annex 10.

6. The panelists evaluate sample by sample (Picture 13), filling out the evaluation form (Annex 10). When they complete the evaluation, the panelists hand in the forms to the facilitator.

7. Participants are informed of the main results of the panel evaluations for appearance, taste, and texture. A wrap-up session can be used to inform about upcoming events (i.e., postharvest evaluation) or activities (i.e., planning of next season’s trials).

8. The previous steps can be repeated with panels in urban centers—for example, at fairs, regular markets (Picture 14), supermarkets, or restaurants. Annex 10 can also be used to record and process this information.
Picture 13. A farmer panel during an organoleptic evaluation at a field day.

Picture 14. Organoleptic evaluation with consumers taking place at a retail market.
Postharvest evaluation
The postharvest evaluation basically involves storage characteristics of the clones and control varieties either in ware potato stores or seed potato stores, depending on local relevance. The main reason relates to the fact that farmers often do not like to manipulate potatoes once stored, particularly seed potatoes, as the dormancy can be broken. However, if this is not a limitation, postharvest evaluation can be performed starting in the first year of the PVS process.

Right after the harvest, a sample of 10 healthy commercial tubers from each clone or control variety per replication must be separated. Each sample from the net bag is placed in a local storage facility. This can be a traditional dark store, a diffused light store, or a cold store, depending on local practice (see Picture 15). Samples are placed in the store in the same net bags used at harvest, in small boxes, or in any other way that makes it easy to identify and evaluate them. The respective code or registration number added on a paper tag for easy identification is also maintained. The variables are recorded on Form F8: Assessment of Dormancy and Sprouting Behavior (Annex 11).

4.1 Who participates in this evaluation?

In the first evaluation (45 DAH), only the coordinator is in charge of the MBTs, but at the time of the second evaluation (90 DAH), a small group of female and male farmers is involved.

4.2 How is the evaluation performed?

Preferably, this evaluation is carried out with each family participating in the Mother and/or Baby trials (at least four households and their storage practices). The evaluations at 45 and 90 DAH last less than 2 hours each. These evaluations can be conducted inside or near the storage facility. The postharvest evaluation comprises three steps:

1. Standard postharvest assessment
2. Gathering (free-listing) and ranking of selection criteria
3. Selection of preferred clones

4.3 What materials are needed for this evaluation?

For the standard yield evaluation:

- Precision scale for weight measurements
- Paper bags for about ten tubers each
- Markers, pencils, tape, paper labels
- Form 8: Assessment of Dormancy and Sprouting Behavior (Annex 11) printed in advance to register data.

Participatory selection:

- Cards to identify the clones
- Flipchart to provide basic explanations and list of results; Forms F1 and F9 (Annexes 5 and 12) to summarize results from postharvest evaluation can be drawn in advance
Tip!

We recommend that you start postharvest evaluations only after two selection years, and only involving the best performing clones and all control varieties.

Tip!

We recommend having at least five female and five male participants. Yet storages are often small and farmers generally do not like it when too many people enter the store. Select the size of the group based on what is locally acceptable.
• Containers (paper bag, small cardboard or plastic box) to deposit the grains (ranking)
• Seeds from two crops (e.g., corn and beans) to cast votes
• Tape and markers

**STEP 1: Standard evaluation: number of sprouts, tuber weight, and health**

1. These actual standard evaluations are conducted at 45 and 90 DAH. However, the initial weight of the 10 healthy tubers of each clone/control variety per replication is recorded at harvest or when the samples are stored.

2. For the first standard evaluation at 45 DAH, the measurements outlined below are performed for each clone/control variety per replication (10 tubers):

   • Number of tubers with sprouts. Average number of sprouts per tuber. Number of tubers affected by damage from pests/diseases.

   • Data are recorded on Form 8: Assessment of Dormancy and Sprouting Behavior (Annex 11). After the examination, the potatoes are stored again.

3. For the second standard evaluation at 90 DAH, the measurements outlined below are performed for each clone/control variety per replication (10 tubers):

   • Number of tubers with sprouts. Average number of sprouts per tuber.
   - Determination of the predominant sprouting behavior (see Annex 13). (1) A single apical sprout or an average of fewer than two sprouts per tuber observed at the end of the test indicates the prevalence of an apical dominance, even if the additional sprout shows a growth rate almost to the same as that of the apical sprout. (2) An average of fewer than three developed sprouts, of which one is the apical, may still be considered a partial dominance. (3) An average number of three or more sprouts per tuber indicating the absence of apical dominance or a pattern of multiple sprouts may be considered a multiple dominance (Carli et al. 2016).

   • Then, in the 10 tubers of each clone or control variety per replication it is evaluated as follows:

     - Weight of the tubers with sprouts
     - Weight of the tubers without sprouts (sprouts have to be removed)
     - Number of tubers affected by damage from pests/diseases

   Once more, data are recorded on Form 8 (Annex 11).

**STEP 2: Gathering and ranking of selection criteria at the postharvest stage**

This evaluation takes place at 90 DAH. This step follows the same exercises as described for the Gathering and Ranking of Selection Criteria at the Flowering and Harvest Stages. The only difference is that now the desired traits and characteristics of the stored tuber will be dealt with. Another difference is that the evaluation will not be performed in the field but close to the seed or ware potato store.

**Gathering of selection criteria (free-listing)**

1. The small group of farmers, men and women, are gathered and the overall objectives of targeted evaluation activity and STEP 2 are briefly explained. This step takes place before participants actually observe the tuber samples taken out of the storage.

2. Then, ask the following question: What do you look for in a new variety of potato when the tubers need to be stored?
3. The greatest number of possible answers is encouraged, and a list is compiled of all the storage-related criteria mentioned by the participants (i.e., free-listing)—for example, long dormancy, resistance to tuber moth, and few but robust sprouts. Each criterion is listed and written on a paper bag (or card with accompanying container) as well as on a flipchart.

**Prioritization of selection criteria (weighted ranking)**

1. To select the most important traits or storage characteristics, a voting (or ranking) process is conducted with the participants. Thus, each of the mentioned criteria or traits is written on a paper bag or on a cardboard tray.

2. Ask farmers to select the three criteria that each considers the most important. Once more, they need to vote for each criterion or trait as they would vote during presidential elections in their country, having three choices in this case.

3. To proceed with the ranking process, six seeds are given to each participant. Once more, in order to differentiate men’s and women’s votes, they are given different seeds.

4. The paper bags, trays, or containers are put in a line so farmers can cast their vote by depositing the seeds, considering the following guidelines:
   - Three seeds for the most important trait or characteristic
   - Two seeds for the second most important trait or characteristic
   - One seed for the third most important trait or characteristic

5. The participants are invited to cast their votes and choose the three most important traits according to their individual preferences. The facilitator reminds the participants to vote one at a time.

**Processing and discussing the results**

- The final list and scores should be written down on a flipchart, where Form F1: Selection Criteria (Annex 5) can be drawn in advance.
- Once all the farmers have voted, the votes (seeds) are counted and the results written down on the flipchart (see Table 4 for an example). The facilitator can generate a quick preference rating for the criteria from the number of votes cast for the different traits or characteristics.
- The results from the voting process are shared with the participants for discussion, to determine whether they have captured their preferences, and to find out why people preferred specific characteristics over others.
- The results should be recorded on Form F1: Selection Criteria (Annex 5) by the technician for further analysis once all the evaluations have been conducted. This form collects the raw data to be stored in the database.

**STEP 3: Ranking of the best clones in storage (postharvest)**

This evaluation takes place at 90 DAH for tuber samples in store. The basic exercises for the ranking of preferred clones at the postharvest stage are identical to those conducted at the flowering and harvest stages. The exercise will be even quicker, since samples from the seed or ware potato store are organized inside the store or close to the store:

1. Before the voting process, the clones and control varieties (every replication) should be clearly marked (e.g., with a piece of cardboard). Normally the materials are in a little box, on a plate, or in net bags.

2. A container is placed in front of each of the samples of the different clones or candidate varieties.

3. The farmers receive a short explanation about the exercise and the objective of evaluating the materials for storage behavior.

4. Participants observe the clones and control varieties and are asked to identify their own personal favorites based on storage traits (clones or
control varieties). Participants are reminded to keep the characteristics and traits from STEP 2 in mind.

5. Once more, six seeds from two different crops (r/g./ maize and beans) are given to each female and male farmer. The standard guidelines for the weighted ranking are repeated: (1) three grains for the best clone, (2) two grains for the second most preferred clone, and (3) one grain for the third most preferred clone.

6. Next, participants are encouraged to select the top three materials (clones or control varieties) they consider to be the best under prevalent storage conditions. Reiterate that votes are individual and that discussion is best reserved for the meeting after voting. Three rounds of voting are needed, one for each replication. Once all participants have cast their votes, the facilitator gathers the containers and counts the number of seeds assigned to each clone, control variety, and replication.

7. The facilitators then generate a summary of the results for feedback to the group (see Table 5 for an example). The results are later also transferred to Form F9: Ranking of the Clones in Storage (Annex 12).

8. The results from the voting process are shared with the participants to discuss and reflect on why people preferred specific clones or control varieties over others. This is also an opportunity to pay attention to any gender differences that may occur for storage behavior.

9. A brief wrap-up is held, and participants are informed that the evaluation will continue when materials are planted for the next season’s trials.
Statistical analysis of experimental data
5.1 Systematic data compilation and storage

For a typical PVS running up to a formal variety release, three to four agricultural seasons are needed to obtain sufficient data and evidence. It is important that the coordinating institution compiles and stores the data from each trial. Once evaluations have been conducted, the data should ideally be recorded on the different forms as provided in Annexes 5–12. These forms are adapted to be read by the CIP-developed highly interactive data analysis platform (HIDAP), in order to collect data and perform the statistical analysis.

5.2 Data analysis and statistical tests

Table 6 lists the forms and statistical tests that could be used for the analysis of collected data in the different evaluations. HIDAP consolidates and processes each of these forms automatically and generates reproducible statistical reports and graphics that allow the promising clones to be selected.

- **Frequency analysis:** This will help to identify the criteria of interest and the aspects to be evaluated through graphics.

- **Friedman test:** This is a non-parametric statistical test of an RCBD and provides an alternative to the two-way analysis of variance (ANOVA). It is used to detect differences in treatments across multiple test attempts. The procedure involves ranking each row (or block) together, then consider the value of rank by columns.

- **ANOVA:** This is a statistical parametric technique used to evaluate differences among means of different groups (also called treatments or populations). ANOVA can be used if the sample has normal distribution (Shapiro & Wilk, 1965) and can be applied with any linear model, such as the one corresponding to the RCBD or complete random design (CRD) (Calzada, 1970), proposed in this guide.

- **Tukey Test and LSD:** They are used to evaluate differences among averages of clones and varieties. These analyses allow performing multiple comparisons of performance data for the M&B plot. Tukey test controls the probability of mak-

Tip!

The storage of the results obtained in the field test is important to build a solid case toward formal variety release. National variety release requirements may demand additional trials or tests or seed multiplication. Make sure, if feasible, that such trials are run in parallel and the data are made available.
Table 6. Components and tests to analyze data by each evaluation stage

| Components | Evaluation Phase | Statistical Test |
|------------|------------------|------------------|
|            | Flowering        | Harvest          | Postharvest |
| Form F1: Selection criteria: Gathering and ranking of criteria | X | X | X | Frequency analysis |
| Forms F2, F3, and F9: Selection of clones: Flowering, harvest, and postharvest ranking of the preferred clones | X | X | X | Friedman Test |
| Forms F4 and F5: Standard evaluation of yield | X | | | ANOVA (RCBD)/ Tukey Test or least significant difference |
| Forms F6 and F7: Organoleptic evaluation (MBTs) | | X | | PCA/Friedman Test |
| Form F8: Assessment of dormancy and sprouting behavior | | | X | ANOVA (CRD)/ Tukey Test or LSD |
| Selection of promissory clones | X | X | | PCA |

...ing a type I error in the group of comparisons, while the least significant difference (LSD) test does it for each individual comparison.

- **Principal component analysis (PCA):** This is a data reduction technique. Components can be calculated from the correlation matrix (the default) or the covariance matrix. This analysis could be done using the scores obtained from the organoleptic evaluations considering information from each panelist regarding each variety feature (i.e., appearance, flavor, and texture).

- **Selection of promising clones:** The PCA will also be used for the selection of promising clones to be used in the next evaluation cycle. This analysis can be used with all average values of the characteristics assessed in the different phases of PVS. It will be possible to use an example with the input and output data of PVS, using the MBT methodology, HIDAP software, protocols, and forms that can be found in their electronic version at: https://research.cip.cgiar.org/potatoknowledge/pvs

## 5.3 Other considerations

- **Gender:** Without considering the role of gender, critical components necessary for the generation and evaluation of technologies may be missed, rendering them less successful and less likely to benefit both men and women. It is therefore important to stress that the analysis and reporting process should build on the gender sex-disaggregated data that the MBTs generate. The particular significance of sex-disaggregated data lies in their ability to prevent gender blindness by informing breeders and stakeholders involved in
variety dissemination. Gender analysis aims to “illuminate differences in the needs, roles, statuses, priorities, capacities, constraints, and opportunities for women and men” (Kauck et al. 2010).

- **Open access**: Data should be made available, at least for consortium members during the execution of MBTs. It is crucial that data and information be available and shared with farmers whenever requested. As soon as the trials are completed, varieties have been released, and/or publications have been ensured, we recommend that the data be published on an open-access platform as well.
Acronyms
| **ANOVA** | Analysis of variance |
| **CIP** | International Potato Center |
| **CRD** | Completely randomized design |
| **DAH** | Days after harvest |
| **EU** | European Union |
| **HIDAP** | Highly interactive data analysis platform |
| **IICA** | Interamerican Institute for Cooperation on Agriculture |
| **M&B** | Mother and Baby |
| **MBTs** | Mother & Baby Trials |
| **NGO** | Nongovernmental organization |
| **PCA** | Principal component analysis |
| **PVS** | Participatory varietal selection |
| **RCBD** | Randomized complete block design |
7 Bibliography
Badu-Apraku, B., M.A.B. Fakorede, A. Menkir, and D. Sanogo, eds. 2012. Conduct and management of maize field trials. IITA, Ibadan, Nigeria.

Calzada, B.J. 1970. Métodos estadísticos para la investigación. 3rd ed. Lima, Peru. Ed. Jurídico, 643 p.

Carli, C., E. Mihovilovich, and M. Bonierbale. 2016. Procedures for standard evaluation and data management of advanced potato clones. Module 4: Assessment of dormancy and sprouting behavior of elite and advanced clones. International Cooperators’ Guide. Lima, Peru. International Potato Center. 31 p.

Chambers, R. 2002. Participatory workshops: A sourcebook of 21 sets of ideas and activities. Routledge Press, UK.

[CIP] International Potato Center. 2012. Catálogo de nuevas variedades de papa: sabores y colores para el gusto peruano. Centro Internacional de la Papa, Ministerio de Agricultura, Instituto Nacional de Innovación Agraria, Lima, Peru.

Fonseca, C., S. De Haan, E. Salas, and F. De Mendiburu. 2010. Guía de evaluación y recolección de datos: metodología Mama & Bebe para la selección participativa de variedades. Centro Internacional de la Papa, Red LatinPapa, Lima, Peru.

Grüneberg, W.J., R. Mwanga, M. Andrade, and J. Espinoza. 2009. Selection methods. Part 5: Breeding clonally propagated crops. In Plant breeding and farmer participation, ed. S. Ceccarelli, E.P. Guimarães, and E. Weltzien, 275–322. Rome, Italy: Food and Agriculture Organization of the United Nations.

Kauck, D., S. Paruzzolo, and J. Schulte. 2010. CGIAR gender scoping study. International Center for Research on Women, Washington, DC.

Klawitter, M., J. Henson Cagley, G. Yorgey, M.K. Gugerty, and L. Anderson. 2009. Gender cropping series: Wheat in sub-Saharan Africa. Evans School Policy Analysis and Research, University of Washington, Seattle, WA.

Leduc, B. 2009. Guidelines for gender sensitive research. International Center for Integrated Mountain Development. Kathmandu, Nepal.

Paris, T., A. Singh, J. Luis, with H.N. Singh, O.N. Singh, S. Singh, R.K. Singh, and S. Sakarung. 2001. Listening to farmers’ perceptions through participatory rice varietal selection: A case study in villages in Eastern Uttar Pradesh, India. Paper presented at the System-wide Program on Participatory Research and Gender Analysis for Technology and Institutional Innovation Workshop. May 1–5, 2000, Pokhara, Nepal.

Paris, T.R., A. Singh, V.N. Singh, and P.C. Ram. 2006. Mainstreaming social and gender concerns in participatory rice varietal improvement for rainfed environments in Eastern India. Paper presented at the International Symposium on Participatory Breeding and Knowledge Management for Strengthening Rural Livelihoods, 17–19 July, M. S. Swaminathan Research Foundation, Chennai, India.

Pretty, J.N., I. Gujut, J. Thompson, and I. Scoones. 1995. Participatory learning and action: A trainers guide. IIED participatory methodology series. London: International Institute for Environment and Development.

Quisumbing, A.R., and L. Pandolfelli. 2009. Promising approaches to address the needs of poor female farmers. IFPRI Discussion Paper 00882. Washington, D.C.: International Food Policy Research Institute.

Shapiro, S.S., and M.B. Wilk. 1965. Analysis of variance test for normality. Biometrika 52:591–611.

Snapp, S. 1999. Mother and Baby trials: A novel trial design being tried out in Malawi. In TARGET. The Newsletter of the Soil Fertility Research Network for Maize-Based Cropping Systems in Malawi and Zimbabwe. January 1999 issue. CIMMYT, Zimbabwe.

Wangchuk, P., S. De Haan, and R. Dochen. 2015. Participatory varietal selection using Mother and Baby trial design in potato. Department of Agriculture Ministry of Agriculture and Forests, Thimpu, Bhutan.

Witcombe, J.R., D.S. Virk, and J. Farrington, eds. 1998. Seeds of choice: Making the most of new varieties for small farmers. New Delhi, India: Oxford & IBH Publishers.
## Annex 1. Minimal Trial Information

| Factor                        | Value |
|-------------------------------|-------|
| Title                         |       |
| Trial name                    |       |
| Leader                        |       |
| Collaborators                 |       |
| Identifier                    |       |
| Contact name                  |       |
| Contact affiliation           |       |
| Contact email                 |       |
| Description                   |       |
| Subject                       |       |
| Keyword                       |       |
| Crop                          |       |
| Type of Trial                 |       |
| Language                      |       |
| Contributor center            |       |
| Contributor CRP               |       |
| Contributor funder            |       |
| Contributor researcher        |       |
| Contributor research group    |       |
| Begin date                    |       |
| End date                      |       |
| Embargo end date¹             |       |
| Format                        |       |
| Related material              |       |
| Software name                 |       |
| Version                       |       |
| Other references              |       |
| CIP Region                    |       |
| Continent                     |       |
| Country                       |       |
| Site short name               |       |
| Admin¹                        |       |
| Admin²                        |       |
| Admin³                        |       |
| Locality                      |       |
| Elevation                     |       |
| Latitude                      |       |
| Longitude                     |       |

1. Distribution limit date of dataset
2. Admin 1, 2, 3. Administrative division, political and geographic of each country
Annex 2. Trial installation

| Factor                                           | Mother | Baby_1 | Baby_2 | Baby_3 |
|-------------------------------------------------|--------|--------|--------|--------|
| Experimental design                             |        |        |        |        |
| Labels for factor genotypes                      |        |        |        |        |
| Experimental design abbreviation                |        |        |        |        |
| Number of replications or blocks                 |        |        |        |        |
| Experimental Environment                        |        |        |        |        |
| Plot start number                               |        |        |        |        |
| Number of plants planted per plot               |        |        |        |        |
| Number of plants per sub-plot                   |        |        |        |        |
| Number of rows per plot                         |        |        |        |        |
| Number of rows per sub-plot                     |        |        |        |        |
| Number of plants per row                        |        |        |        |        |
| Plot size (m²)                                  |        |        |        |        |
| Distance between plants (m)                     |        |        |        |        |
| Distance between rows (m)                       |        |        |        |        |
| Planting density (plants/Ha)                    |        |        |        |        |
| Planting mode                                   |        |        |        |        |
| Area of the experiment                          |        |        |        |        |
| Total number of participants flowering phase    |        |        |        |        |
| Number of participants women flowering phase    |        |        |        |        |
| Number of participants men flowering phase      |        |        |        |        |
| Type of harvest                                 |        |        |        |        |
| Total number of participants at harvest          |        |        |        |        |
| Number of participants women at harvest          |        |        |        |        |
| Number of participants men at harvest            |        |        |        |        |
| Locality of storage                             |        |        |        |        |
| Type of storage                                 |        |        |        |        |
| Name of farmer                                  |        |        |        |        |
| Area dedicated to potato                        |        |        |        |        |
| Initial sprout length                           |        |        |        |        |
| Field history cropping season 1                 |        |        |        |        |
| Field history cropping season 2                 |        |        |        |        |
| Field history cropping season 3                 |        |        |        |        |
| Field history cropping season 4                 |        |        |        |        |
| Field history cropping season 5                 |        |        |        |        |
Annex 3. Material List

| Seed Origin | Order Institutional Number | Name of Clone or Variety | Breeding Code | Male Parental Code | Female Parental Code |
|-------------|-----------------------------|--------------------------|---------------|-------------------|----------------------|
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
|             |                             |                          |               |                   |                      |
| Intervention Category | Intervention Type   | Date                  | Operator | Observations | Active Ingredient | Product Concentration | Dose of Application | Uncertainty of Measurement |
|-----------------------|---------------------|-----------------------|----------|--------------|-------------------|-----------------------|----------------------|--------------------------|
| Preparation           | Fertilizers         |                       |          |              |                   |                       |                      |                          |
| Preparation           | Fertilizers         |                       |          |              |                   |                       |                      |                          |
| Preparation           | Fertilizers         |                       |          |              |                   |                       |                      |                          |
| Preparation           | Fertilizers         |                       |          |              |                   |                       |                      |                          |
| Preparation           | Planting            |                       |          |              |                   |                       |                      |                          |
| Evaluations           | Emergency (>50 percent) |                     |          |              |                   |                       |                      |                          |
| Management            | First hilling       |                       |          |              |                   |                       |                      |                          |
| Management            | Second hilling      |                       |          |              |                   |                       |                      |                          |
| Applications          | Fungicide           |                       |          |              |                   |                       |                      |                          |
| Applications          | Insecticide         |                       |          |              |                   |                       |                      |                          |
| Applications          | Insecticide         |                       |          |              |                   |                       |                      |                          |
| Evaluations           | Evaluation flowering phase |                   |          |              |                   |                       |                      |                          |
| Management            | Vine cutting/killing |                     |          |              |                   |                       |                      |                          |
| Management            | Date of dehauling (dd-mm-yyyy) |                |          |              |                   |                       |                      |                          |
| Management            | Weed Management     |                       |          |              |                   |                       |                      |                          |
| Evaluations           | Evaluation Harvest phase |                   |          |              |                   |                       |                      |                          |
| Harvest               | Date of Harvest (dd-mm-yyyy) |                |          |              |                   |                       |                      |                          |
| Postharvest           | Date of storage (dd-mm-yyyy) |               |          |              |                   |                       |                      |                          |
Annex 5. Form F1: Selection Criteria (Flowering, Harvest and Postharvest Stage)

| Order | Phase     | Identified criteria | Men Score Hombres (N° of corn seeds) | Order of Importance Men | Women Score (N° of beans) | Order of Importance Women | Score Global |
|-------|-----------|---------------------|--------------------------------------|-------------------------|---------------------------|---------------------------|--------------|
| 1     | Flowering |                     |                                      |                         |                           |                           |              |
| 2     | Flowering |                     |                                      |                         |                           |                           |              |
| 3     | Flowering |                     |                                      |                         |                           |                           |              |
| 4     | Flowering |                     |                                      |                         |                           |                           |              |
| 5     | Flowering |                     |                                      |                         |                           |                           |              |
| 1     | Harvest   |                     |                                      |                         |                           |                           |              |
| 2     | Harvest   |                     |                                      |                         |                           |                           |              |
| 3     | Harvest   |                     |                                      |                         |                           |                           |              |
| 4     | Harvest   |                     |                                      |                         |                           |                           |              |
| 5     | Harvest   |                     |                                      |                         |                           |                           |              |
| 1     | Storage   |                     |                                      |                         |                           |                           |              |
| 2     | Storage   |                     |                                      |                         |                           |                           |              |
| 3     | Storage   |                     |                                      |                         |                           |                           |              |
| 4     | Storage   |                     |                                      |                         |                           |                           |              |
| 5     | Storage   |                     |                                      |                         |                           |                           |              |

Annex 6. Form F2: Selection of Clones at Flowering Stage

| Plot | REP | Institutional Number | Plot Mother Score by Men (N°of corn seeds) | Plot Mother Score by Women (N°of beans) | Plot Mother Score Global | Plot Baby Score by Men (N°of corn seeds) | Plot Baby Score by Women (N°of beans) | Plot Baby Score Global |
|------|-----|----------------------|-------------------------------------------|-----------------------------------------|--------------------------|------------------------------------------|----------------------------------------|------------------------|
| *PLOT | *REP | *INSTN | *MSM | *MSWM | *MSGLO | *BSM | *BSWM | *BSGLO |

*Abbreviations used in the HIDAP software template: PVS Module
Annex 7: Form F4: Standard Evaluation of Yield (Mother trial)

| Plot | REP | Institutional Number | Number of Tubers Planted | Number of Plants Harvested | Number of Marketable Tubers/Plot | Number of Nonmarketable Tubers/Plot | Marketable Tuber Weight (kg/plot) | Nonmarketable Tuber Weight/Plot | Total Number of Tubers/Plot | Total Tuber Weight (kg/plot) |
|------|-----|-----------------------|--------------------------|---------------------------|----------------------------------|-----------------------------------|---------------------------------|------------------------------|----------------------------|----------------------------|
| *PLOT | *REP | *INSTN | *NTP | *NPH | *NMTP | *NNoMTP | *MTWP | *NoMTWP | *TNTP | *TTWP |

* Abbreviations used in the HiDAP software template: PVS Module
### Annex 8. Form F5: Standard Evaluation of Yield (Baby trial)

| Parameter                                      | Abbreviation |
|------------------------------------------------|--------------|
| Total Tuber Weight (kg/plot)                  | MTWP         |
| Total Number of Tuber/Plot                    | MTBP         |
| Nonmarketable Tuber Weight/Plot (kg/plot)     | NoMTWP       |
| Marketable Tuber Weight/Plot (kg/plot)        | MTWP         |
| Number of Nonmarketable Tubers/Plot           | NMTWP        |
| Number of Marketable Tubers/Plot              | NMTP         |
| Number of Plants Harvested                    | NPH          |
| Number of Tubers Planted                      | NTP          |
| Institutional Number                          | INSTN        |
| REP                                           | REPT         |
| Plot                                          | PLOT         |

*Abbreviations used in the HIDAP software template: PVS Module*
Annex 9. Form F3: Ranking of the Clones at Harvest Stage

| Plot | REP | Institutional Number | Plot Mother Score by Men (N° of corn seeds) | Plot Mother Score by Women (N° of beans) | Plot Mother Score Global | Plot Baby Score by Men (N° of corn seeds) | Plot Baby Score by Women (N° of beans) | Plot Baby Score Global |
|------|-----|----------------------|--------------------------------------------|-----------------------------------------|--------------------------|------------------------------------------|----------------------------------------|---------------------------------------|
|      |     |                      |                                            |                                         |                          |                                          |                                        |                         |
|      |     |                      |                                            |                                         |                          |                                          |                                        |                         |
|      |     |                      |                                            |                                         |                          |                                          |                                        |                         |
|      |     |                      |                                            |                                         |                          |                                          |                                        |                         |
|      |     |                      |                                            |                                         |                          |                                          |                                        |                         |

* Abbreviations used in the HIDAP software template: PVS Module

Annex 10. Forms F6 and F7: Organoleptic Evaluation

| Number of panel | Type of trial | Name of evaluator | Sex |
|-----------------|---------------|-------------------|-----|
|                 |               |                   |     |
|                 |               |                   |     |

| Variable       | Attributes    | Grade | Clone 1 | Clone 2 | Clone 3 | Clone 4 | Clone 5 |
|----------------|---------------|-------|---------|---------|---------|---------|---------|
| APPEARANCE     | Excellent     | 😊 5  |         |         |         |         |         |
|                | Fair          | 😊 3  |         |         |         |         |         |
|                | Poor          | 😞 1  |         |         |         |         |         |
| TASTE          | Excellent     | 😊 5  |         |         |         |         |         |
|                | Fair          | 😊 3  |         |         |         |         |         |
|                | Poor          | 😞 1  |         |         |         |         |         |
| TEXTURE        | Mealy floury  | 😊 5  |         |         |         |         |         |
|                | Intermediate  | 😊 3  |         |         |         |         |         |
|                | Soggy watery  | 😞 1  |         |         |         |         |         |

* In HIDAP software, module PVS, the form 6 registers the results of the organoleptic evaluation of the mother plot. And form 7, the results of the organoleptic evaluation of the baby plot.
### Annex 11. Form F8: Assessment of Dormancy and Sprouting Behavior

| Plot Rep | Institutional Number | Storage Type | Initial Tuber Weight Evaluated (g) | Number of Tuber Evaluated | Number of Tuber with Sprouts (Evaluation 1) | Number of Tuber with Sprouts (Evaluation 2) | Average Sprout Number per Tuber (Evaluation 1) | Number of Tuber with Sprouts (Evaluation 2) | Average Sprout Number per Tuber (Evaluation 2) | Number of Tuber Affected by Damage (Evaluation 1) | Number of Tuber Affected by Damage (Evaluation 2) | Final Tuber Weight with Sprouts Removed (g) | Final Tuber Weight with Sprouts Removed (g) |
|----------|----------------------|--------------|-----------------------------------|---------------------------|---------------------------------|---------------------------------|-----------------------------------|---------------------------------|-----------------------------------|---------------------------------|---------------------------------|-----------------------------------|-----------------------------------|
| *PLOT*   | *REPT*               | *STY*        | *NTE*                             | *NSTEM*                   | *NTSP* EV1                      | *NTSP* EV2                      | *AVSNTEV1*                      | *NTSP* EV2                      | *AVSNTEV2*                      | *NTDM EV1*                      | *NTDM EV2*                      | *FTWSP*                          | *FTWSP*                          |

* Abbreviations used in the HIDAP software template: PVS Module
Annex 12. Form F9: Ranking of the Clones in Storage

| Plot | REP | Institutional Number | Storage Type | Men Score (N°of corn seeds) | Women Score (N°of beans) | Score Global |
|------|-----|----------------------|--------------|-----------------------------|--------------------------|--------------|
|      |     |                      |              |                             |                          |              |
|      |     |                      |              |                             |                          |              |
|      |     |                      |              |                             |                          |              |
|      |     |                      |              |                             |                          |              |
|      |     |                      |              |                             |                          |              |

Annex 13. Sprouting Pattern Evaluation

| Apical Dominance (AP) | Partial Dominance (PD) | Multiple Dominance (MD) |
|-----------------------|------------------------|-------------------------|
| ![Image](image1.png)  | ![Image](image2.png)  | ![Image](image3.png)  |

Only one apical sprout or an average of fewer than two sprouts per tuber, **apical dominance (AP)**.

An average of fewer than three developed sprouts, **partial dominance (PD)**.

An average number of three or more sprouts per tuber indicates the absence of apical dominance or a multiple sprouting pattern, **multiple dominance (MD)**.

Carli et al., 2016
Appendix 14. Photographic Record

Evaluation at the time of flowering

The control clones and varieties must be labeled using anonymous identifiers (such as numbers), and the bags or trays should be placed in the field before the participants arrive. This saves time and makes voting more effective. Photo: R. Ccanto (2016). Junín, Peru.

Photo: P. Wangchuk (2015). Trashigang, Butan.
Many grains from different crops are used to differentiate the votes of men from women—for example, maize for men and beans for women. These will be used in the ranking of selection criteria and ranking of the best clones at the time of flowering, harvest, and postharvest. Photo: M. Pacheco (2009). Cusco, Peru.
Ranking of selection criteria. Photo: C. Bastos (2011). Huancavelica, Peru.

Ranking of the best clones at the time of flowering. When voting, women could vote before men so that they are not influenced by them. Photo: R. Ccanto (2016). Junín, Peru.
The paper bags, trays, or containers are placed in front of each clone so that farmers can vote by putting the grains inside. Photo: M. Pacheco (2009). Cusco, Peru.
Evaluation at the time of harvest

Standard yield evaluation. We recommend that the Mother plot be harvested 1 day before and to have each plot and replication properly labeled and ready for the farmers to evaluate. Photo: C. Fonseca (2009). Huancayo, Peru.

Gathering and ranking of selection criteria at the time of harvest. Men and women casting their votes for the most important traits and characteristics for production. Left Photo: C. Fonseca (2012). Huancavelica, Peru. - Right Photo: C. Fonseca (2009). Cusco, Peru.
Ranking of the best clones at the time of harvest. Men and women go into the field to appreciate the clones to be evaluated. Afterward, they vote the most important characteristics for production. Left Photo: C. Fonseca (2010). Huancavelica, Peru. - Right Photo: C. Bastos (2012). La Libertad, Peru.
Organoleptic evaluation is performed with small groups of farmers. The material for this evaluation must be provided by the technical team. Photo: C. Fonseca (2009). Huancavelica, Peru.

Each participant is assigned a maximum of 5 or 6 clones and a control variety for evaluation. The three components of organoleptic evaluation are explained: appearance, taste, and texture. Left Photo: C. Lefebvre (2009). Negale, Nepal. - Right Photo: C. Ccanto (2009). Huancavelica, Peru.
Evaluation at the time of postharvest

After harvest, 10 healthy marketable tubers from each clone and variety per replication must be separated. These samples are weighted in net bags and stored in a local warehouse. Photo: A. Janampa (2011). Huancavelica, Peru.

Ninety DAH, the evaluations allow the optimum time and sprouting pattern of each clone to be determined. Photo: A. Janampa (2011). Huancavelica, Peru.
Gathering and ranking of selection criteria at the time of postharvest (90 DAH). Often the warehouses are small so that farmers generally do not like many people inside. Select the size of the group according to what is socially acceptable. Photo: N. Zuñiga (2011). Junín, Peru.
CIP is a research-for-development organization with a focus on potato, sweetpotato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.

www.cipotato.org

CIP is a CGIAR research center
CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 research centers in close collaboration with hundreds of partners across the globe.

www.cgiar.org

The European Union is made up of 27 Member States who have decided to gradually link together their know-how, resources and destinies.
Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.