Project TAP–5: The Collaborative Breeding of Five Tropically Adapted Potato Varieties

Annual Progress Report (2018)

December 2018

Prepared for:
Syngenta Foundation for Sustainable Agriculture

Submitted by:
The International Potato Center (CIP)

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ACRONYMS

BW	Bacterial wilt
CIP	International Potato Center
DCP	Department of Crop Production
DM	Dry matter
FCRI	Field Crops Research Institute
HZPC	HZPC Holding B.V.
LB	Late blight
MARD	Ministry of Agriculture and Rural Development (Vietnam)
PVFC	Potato, Vegetable and Flower Research Center
PVX	Potato virus X
PVY	Potato virus Y
PLRV	Potato leafroll virus
RRD	Red River Delta
SFSA	Syngenta Foundation for Sustainable Agriculture
TS	True seed

1. PROJECT OVERVIEW

Project Name: TAP-5: The Collaborative Breeding of Five Tropically Adapted Potato Varieties

Project Goal: To increase potato productivity, stability, and competitiveness and enhance food security and family income of resource-poor farmers of Southeast Asia.

Collaborating Partners: International Potato Center (CIP), HZPC Holding B.V. (HZPC), and Syngenta Foundation for Sustainable Agriculture (SFSA)

Project Goal: To increase potato productivity and stability, competitiveness, enhancing food security and family income of resource-poor farmers of Southeast Asia.

CIP Program Alignment: Through its Strategic Program, Agile Potato for Asia, CIP aims to improve systems productivity and farm incomes of at least 7m households in targeted Asian countries over the next 10 years. These improvements will be achieved through development and use of early-maturing agile potato varieties that will contribute to enhancing food security and providing reliable sources of equitable income from ware and seed potato value chains.

Shared Institutional Goal: To enhance effectiveness and impact from breeding by combining strengths of the public and private sector.

Executive Summary: Despite being the main non-cereal crop, potato is struggling to gain much-deserved significance in rice-based farming systems of Southeast Asia. The scenario could be attributed to many factors, including non-availability of varieties suitable for rice-cropping system, non-reliable sources of seed, challenging agro-ecologies, lack of infrastructure and expertise, and unfamiliarity of the farmers and consumers about its economic and nutritional benefits. Per capita potato consumption at 4.63 kg in the region is significantly lower if compared with 34.2 kg of global, 38.6 kg of East Asia, and 27.0 kg of South Asia (FAOSTAT 2013). Though consumption is very low, still the region is importing fresh and frozen potatoes worth $450m (ibid.). This interesting statistic clearly indicates the scope of potato as a future value crop if projected and promoted strategically in the region. There is an immediate need to fill the gap of already existing demand and supply, and simultaneously increasing the demand by raising awareness among farmers and consumers. SFSA funded the TAP-5 project, jointly being operated by CIP and the global leading potato seed company HZPC, Holland, which targets development of short-duration table and process varieties, which could fit in the local farming system. The clones from four seed lots of CIP-HZPC crosses are being evaluated at different stages at varied altitudes to test their agroecology-specific responses. From Lots 1 and 2, 51 clones were selected from 496 in Hai Duong (lowland) at F_1C_1 stage during February 2018. A total of 43 selected clones produced better yield than the best check 'Atlantic' in this trial, indicating the yield potential of the population. From the same lots, 13 were selected out of 23 clones at F_1C_2 stages in highlands at Dalat. Three advanced clones produced significantly higher yield than 'Atlantic' in this trial. Dry matter (DM) of one selected clone (HCIP316056.103) was higher than that of 'Atlantic'. Marker analyses of these 23 clones were carried out at HZPC, Holland to determine their resistance against late blight (LB), cyst nematode, and potato virus Y (PVY). Some of these advanced clones were tested in the laboratory for estimation of glycoalkaloids content at CIP–Lima; all were found to have acceptable glycoalkaloid level. The selected clones from F_1C_2 stage are also being multiplied parallel *in vitro* for production of disease-free seed at advanced stage, when required for variety release trials. From Lot 3, 72 clones were selected at F_1C_1 stage from 224 in Dalat during June. All the selected clones

have been planted in November 2018 at farmers' field in Hai Phong and Dalat for further screening. The 13 clones at most advanced stage will be tested further in three different agro-ecologies during three seasons to identify the most promising clones for initiating the varietal registration process. The *in vitro* stock of the shortlisted clones will be used to multiply clean seed required for the varietal registration trials. The facilities for rapid, disease-free multiplication techniques—like aeroponic and rooted apical cutting technology—have been identified in the Potato, Vegetable and Flower Research Center (PVFC), Dalat, and Vietnam National University of Agriculture in Hanoi. With an aim to increase the genetic variability of the material, a new true seed (TS) set of 83 families containing approximately 19,000 seed was received in Vietnam during August 2018 from Lima, Peru. This set is under evaluation under disease-free conditions in screenhouse at PVFC, Dalat. In 2018 six review meetings were held regularly among stakeholders, including a midterm review meeting in Cusco, Peru, and a marketing–brainstorming session in Amsterdam, the Netherlands. A value chain analysis study has been proposed by SFSA and CIP jointly in discussion with HZPC to understand the local potato situation in Vietnam. The aim is to identify challenges and generate recommendations to improve the potato production and marketing.

2. PROGRESS ON TAP-5 PROJECT THROUGH 2018

The present report covers activities carried out from **January to December 2018.** Past start-up information can be referred to from the **previously submitted report of 2017**.

2.1 PEOPLE

During 2018 three new positions were advertised and hired for the implementation of the project activities in Vietnam:

- **Research Associate, Dalat.** Ms. Dinh Thi Hong Nhung, who is working with PVFC, Dalat as a researcher, has been selected for the position. She has been associated with the project since its initial phase as a representative from PVFC, and has more than 8 years of strong experience in potato research. She is responsible for implementing the project's activities in Dalat and surrounding areas at farmer's field and the PVFC campus, including a screenhouse.
- **Research Auxiliary, Dalat.** The position is responsible for taking care of a screenhouse at PVFC, Dalat and helping the research associate collect data. Ms. Nguyen Thi Quang took up this position in May. She has worked with PVFC since 1986, and has more than 30 years of experience in managing potato crops in field and screenhouse conditions.
- **Research Assistant, Hanoi.** A major responsibility of this position is to provide project implementation support in the Red River Delta (RRD). Ms. Phung Ha Trang joined the project in this position in April 2018. She has worked with different organizations, including Syngenta in Hanoi.

In addition to the above positions, Dao Huy Chien's contract was renewed as a consultant for 2018. Neeraj Sharma (a post-doc scientist) is the focal person for Southeast Asia and is coordinating the project's activities with the international collaborators, including HZPC and SFSA. Hugo Campos, Walter Amoros, and Elisa Salas are contributing from CIP–Lima in planning, discussion, and execution. Richard Sanders and Robert Graveland are actively participating from HZPC in implementing field trials, selection, strategies planning, and others. The project is also being supported by other scientists of both the organizations on as-needed basis and when required.

It is also worthwhile to mention that SFSA's scientists and staff are regularly participating in discussions, suggestions, and field activities, including harvesting and selections. Mike Robinson, Herve Thieblemont, and Ian Barker are providing their support through personal discussion and suggestions over email communications. Dao Xuan Cuong (SFSA's local contact point in Vietnam) is in regular contact about the progress of the TAP-5 project team and visiting the field trials regularly, besides participating in review meetings.

2.2 GENETICS

2.2.1 Crossing program to increase the genetic variability

For increasing the chances of more selections with broader genetic representation, another crossing program was carried out at Huancayo, Peru. As per agreed plan, HZPC parents as male and CIP parents as females were used. The program involved 9 genotypes from HZPC and 30 genotypes from CIP. (Annexes 1 and 2). HZPC progenitors showed nematode resistance, good tuber appearance, processing quality, and high yield. Female parents from CIP were selected from lowland tropics virus resistance and late blight heat tolerance population. CIP genotypes possessed strong biotic resistances, heat tolerance, earliness, stable yield over varied environments, and tropical adaptation. The female parents were planted in the second week of November 2017, and pollination started in mid-January 2018. Pollens of the selected HZPC parents were sent from Holland to Lima. A total of 103 families with more than 90,000 seeds were developed from this crossing program. CIP clones CIP397006.18 (extreme resistance to PVY and PVX, tolerant to heat and drought); CIP388676.1 (extreme resistance to PVY, excellent for processing); and CIP392820.1 (resistant to PVY, PVX, and potato leafroll virus [PLRV]; tolerant to heat; good combiner for yield, uniformity, and PLRV resistance) were the promising female parents in the crossing program. HZPC clone HOM 13-8236 (resistant to nematode G. rost1 and LB) was the most successful male parent. On the basis of desirable minimum seed quantity, 83 families with more than 18,800 seeds were dispatched to Vietnam in July (Annex 3). The set separated in two consignments of 61 and 22 families was received in August by the Field Crops Research Institute (FCRI) on behalf of CIP.

2.2.2 Clonal selection in Vietnam

Background. A population developed under first crossing program at Peru was shipped in three consignments to Vietnam during 2016 and 2017. First lot (Lot 1) consisted of 55 families, second lot (Lot 2) consisted of 119 families (55 previous families and 64 new families), and third lot (Lot 3) consisted of 49 families. Until September 2018, Lots 1 and 3 were continuously evaluated at mid-elevation tropical highlands in Dalat under Scheme 1 and Scheme 3, respectively. Lot 2 was evaluated in both lowland and highlands under Scheme 2 (Annexes 4–7). Dalat, where potato can be grown throughout the year, has an advantage of conducting more selection cycles per year. Selections in subtropical lowland in the RRD can be carried out only once in a year during winter. In November 2018, material selected from previous cycles was shuttled between these altitudes to test their stability over varied environments.

As discussed above, one more lot (Lot 4), developed by using new cross combinations, was received in August 2018. It is being evaluated under Scheme 4 and is currently at F_1 stage in screenhouse at Dalat.

Scheme-wise selections

1. Schemes 1 and 2

Both Lots 1 and 2 were received at a short interval of 1 month and were evaluated separately in highlands and lowlands at F_1 stage (Lot 1 in Dalat and Lot 2 in the RRD). After making selections in Lot 2 at F_1 stage in the RRD during March 2017, the tubers of the selections were partitioned in two groups—one group was shifted to Dalat for immediate next selections, whereas the other group waited in cold storage in the RRD for the next planting season. The shipped selections from Lot 2 were evaluated together with selections from Lot 1 in Dalat and are at present at most advanced stages of selections at F_1C_3. The second group of selected clones in Hai Duong were evaluated at F_1C_1 stage in February 2018. Selections from this group were planted in November 2018 at F_1C_2 stage for evaluation in Hai Phong in the RRD. The selections made in the RRD for Lot 2 at F_1C_1 stage were also shipped to Dalat and were planted in screenhouse for seed multiplication in June–September 2018. These multiplied clones will be evaluated in Dalat in March–June 2019.

Details of the trials carried out during reported year for Scheme 1 and 2 are a follows:

- **Hai Duong (November 2017–February 2018).** From Lot 2, the selections were planted on November 6, 2017, at FCRI in the RRD during winter. A total of 496 clones selected from Lot 2 at F_1 stage were evaluated in nonreplicated trials: 343 clones were from 55 TS families and 153 clones were from 64 TS families. Data were recorded on growth traits, flowering habit, earliness, and other parameters. At the time of harvesting in February 2018, yield data, tuber traits, and presence of any biotic stresses of the selected clones were recorded. All possible biotic stresses of potato of the region were present in the trial site. Fifty-one clones (40 from 55 TS families and 11 from 64 families) were selected in this trial (Annex 8). Though yield was not a criterion of selections, still 43 clones out of 51 out-yielded the best yielder check ('Atlantic') in the trial, giving a positive indication of the ability of the selected lot to perform better under biotic stresses. Seven selections were from family HCIP316056 (CIP388676.1 x HOM12-7145), followed by four from HCIP316140 (CIP397079.6 x HOM12-7145) and HCIP316041 (CIP304387.39 x HOM 12-7449). The selected clones were cold-stored for next season's planting. Some 3–4 tubers of the selections were shipped to Dalat for their evaluation in highlands.

- **Dalat**

    1. **Farmers' field trials (March–June 2018).** The clones within this group, selected from both Lots 1 and 2, are at most advanced stage of the selection cycle under the TAP-5 project. The farmers' field trials were conducted from March to June in Xuan Tho Village, Dalat, at F_1C_2 stage along with local checks 'Atlantic' and 'Solara'. Sixteen clones with sufficient tubers were evaluated in replicated trial (Annexes 9–11), whereas six clones with smaller number of tubers were evaluated in nonreplicated trial. Owing to very few tubers, clone HCIP316079.206 was multiplied under screenhouse conditions. All the 23 clones were multiplied in parallel under disease-free conditions in screenhouse for future trials. During the cropping season, data were recorded on a prescheduled format on growth traits (i.e., plant vigor, leaf type, plant type, growth habit, senescence, and flowering). Observations were also recorded periodically on all the important diseases prevailing in the region. On the basis of tuber appearance and yield data, 11 clones from replicated and 2 clones from nonreplicated trials were selected. These 13 clones were also evaluated for processing traits like chipping, French fries, and boiling quality (Annex 12). Dried leaf samples and DNA isolate of all the clones were shipped to HZPC for determining their resistance against LB, cyst nematode, and PVY (Annex 13). Freeze-dried samples of some of the selected clones were shipped to CIP–Lima to determine the glycoalkaloid concentration (Annex 13).

Replicated trial. To combine different comparisons, the statistical analysis of the replicated trial was done by using a highly interactive data analysis platform and IRRISTAT. Clones HCIP316121.108 (38.4 t/ha), HCIP316140.210 (38.0 t/ha), and HCIP316069.202 (29.8 t/ha) outperformed best check 'Atlantic' (15.6 t/ha) significantly. Despite having significant higher yield, clone HCIP316069.202 was rejected due to its poor tuber shape. Clone HCIP 316121.108 was the best performer for average marketable tuber weight (192.0 g), followed by HCIP316078.106 (176.7 g) and HCIP 316136.103 (154.2 g). The DNA analysis of all the clones under study revealed that clones HCIP316121.108 and HCIP316140.210 were also resistant to certain strains of LB, potato cyst nematode, and PVY. However, the DM content of high-yielding clones HCIP316121.108 (16.1%) and HCIP316140.210 (15.2%) was low, indicating their suitability only for the table. The DM of only one clone, HCIP316056.103 (22.9%), was better than the best check, 'Atlantic' (20.0%). Glycoalkaloid content of all the tested clones was significantly below the maximum acceptable limit of 7 mg/100 g fresh weight, indicating the suitability of selections even in warmer areas. Overall, under this trial the performance of certain advanced clones was significantly better than the best check 'Atlantic' for yield and related traits. The selected clones are being further evaluated in Dalat and Hai Phong (with sufficient tubers) during the current season to test their performance in varied environment.

Nonreplicated trial. Six clones were evaluated without any replications due to fewer tubers. The trial also included 11 of the selected CIP advanced clones. All the scheduled observations for the replicated trial were recorded in this trial. Two clones from TAP-5 material and 3 clones from CIP population were selected for further evaluation (Annex 14).

2. **Seed multiplication in screenhouse (June–September 2018).** Three tubers of each selected 51 clones from Lot 2 in Hai Duong during February 2018, at F_1C_1 stage were shipped to Dalat. The tubers were sown in clean media in pots in screenhouse to get disease-free planting material for further selections of these clones. The tubers harvested in September are under diffused light storage in Dalat and will be evaluated after dormancy is over.

2. Scheme 3. This scheme involves evaluation of Lot 3, which was received one year later than Lots 1 and 2. Under this shipment, 49 families were received. The families were product of the same crossing program as Lots 1 and 2.

Dalat under screenhouse conditions (March–June 2018). A total of 224 clones selected at F_1 stage in October 2017, were evaluated under this scheme. During the harvesting in October, the soil of the screenhouse was seen to be severely affected by bacterial wilt (BW). Therefore, to improve the selections and planting material, all the selected clones were planted in pots in mixture of coco-peat and sterilized soil in screenhouse. The clones were planted in March and harvested in June 2018. During the growing period, observations were recorded on flowering habit, disease incidence, and plant vigor. Seventy clones were selected based on tuber traits (Annex 15). Yield data of the selected clones were also recorded at the time of selections. A maximum of 6 clones were selected from family HCIP 316177 (CIP398208.620 x HOM12-7145), followed by 5 clones each from HCIP316132 (CIP397006.18 x HOM12-7145), HCIP316040 (CIP304387.39 x HOM12-7145), and HCIP316170 (CIP398208.29 x HOM12-7145). These 70 clones are now being evaluated in the current season under replicated and nonreplicated trials based on the number of tubers available for each clone. Clones with enough tubers have been planted in Hai Phong for their parallel evaluation in lowland conditions.

3. Scheme 4 (November 2018–February 2019). The TS of this lot (Lot 4) was sown on 26 September in a screenhouse. A maximum of 125 seeds were sown of each family, depending on seed numbers, with the possibility to transplant a maximum of 100 seedlings of each family. For families with fewer than 125 seeds, all the seeds were sown. Approximately 7,500 seedlings were transplanted on 5 November in pots in a screenhouse for initial multiplication and selection. This lot will be harvested and selected along with other trials in Dalat in February 2019.

4. Evaluation of advanced CIP material to test their candidature for inclusion in TAP-5. It was decided to observe the performance of already-developed CIP advanced clones in Vietnam. If they match the desired traits of TAP-5 products, they can be included in TAP-5 trials. The team that evaluated clones in Hai Duong during February 2018, also visited selections of CIP clones in Chuong My, Hanoi. The three clones from these selections—CIP 310139.102 (local code- VR1-1-2), CIP310139.147 (local code- VR 1-1-47), and LB 44-1-4-5 with enough tubers—were shipped to Dalat for screening from June to September at PVFC field. The experiment followed Vietnam's national variety release protocol for initial trials. The idea behind this approach is that the same data of promising clones will be forwarded to the variety release committee. In addition, the experience of these trials will help us to prepare better for our future trials required for variety release for other TAP-5 advanced clones.

- **Trial 1**. As per requirements of the national variety release protocol for initial trials, the clones CIP310139.102, CIP310139.147, and LB44-1-4-5, along with local checks PO3, O7, and 'Atlantic', were planted in three replications. Each replication covered a 9-m^2 area accommodating 45 plants. Data on predefined schedule were recorded for different viruses and diseases, plant growth traits, yield, and tuber traits (Annex 16). In addition to the regular protocol, the clones were also tested for DM, chips, and French fries (Annex 17). Clone LB44-1-4-5 produced significantly higher yield (33.0 t/ha) than all other clones under study, including all three local checks. 'Atlantic' was the poorest yielder and produced significantly lowest yield in the group (9.0 t/ha). Clone CIP310139.102 had 22.8% DM, which was better than the best check, 'Atlantic' (22.0%). All other clones and checks were below both the genotypes in term of DM. Interestingly, the chip color score of all the clones and checks was in acceptable range. 'Atlantic' performed best, receiving a perfect score of 1.00 for both chips and French fries. Among clones, CIP310139.102 was found best for chip color (1.86). The rainy season in Dalat runs from June to September; hence for more stable results further evaluation will be carried out.

- **Trial 2**. Six more CIP advanced clones with fewer tubers were evaluated in three replicated trials with same three local checks, 'Atlantic', PO3, and O7 (Annex 18). Each replication covered an area of 1 m^2 and accommodated five plants. The observations were recorded by following the same schedule of variety release protocol. CIP clone CIP314968.73 (32.0 t/ha) produced significantly higher yield than 'Atlantic' (26.0 t/ha). But none of the clones could outperform the local varieties for total yield.

2.3 CURRENT ACTIVITIES

2.3.1 Dalat

- Thirteen clones selected from sets 1 and 2 in farmers' field trials are planted in farmers' field at F_1C_3 stage under replicated trials. Also, clone HCIP316079.216, which could not be evaluated in previous trial due to smaller number of tubers, is under evaluation in the field this time.

- Seventy clones (selected from Hai Duong) multiplied from F_1C_1 stage in screenhouse are planted in farmers' fields under replicated trials.

- Three advanced CIP clones are being evaluated at farmers' fields under replicated trial by following the national variety release protocol, along with local checks 'Atlantic', PO3, and O7.
- Approximately 7,500 seedlings of 83 families are being evaluated in screenhouse to make selection at F_1 stage.
- *In vitro* multiplication of advanced selected clones is underway in laboratory at PVFC.

2.3.2 Hai Phong (RRD)

- Fifty-three clones selected from last season in Hai Duong have been planted in three replications in November and are under evaluation.
- Five advanced CIP clones are being evaluated by following national variety release protocol, along with the local checks 'Atlantic', 'Marabel', and 'Solara'.
- A total of 48 shipped clones from Dalat selection (from the lot of 70 clones with extra tubers) are under evaluation to test their suitability at F_1C_2 stage under replicated trial.
- Eight shipped clones from farmers' field selection in Dalat (from the lot of 23 clones with extra tubers) are under evaluation to test their suitability in lowland tropics at F_1C_3 stage.

2.4 SUPPORTING APPROACHES ADOPTED IN THE PROJECT

The project aims to identify both table purpose and processing clones suitable for varied agro-ecologies in short span as compared with the lengthy regular breeding cycle in potato. To hasten the pre- and postselection processes, in addition to shuttle breeding, other issues are also being identified, discussed, and addressed. This integrated approach includes adoption of modern technologies for preselection stage and managerial issues for postselection stages.

Preselection stage. Disease-resistance ability and glycoalkaloid content for faster and successful adoption of the selections will be determined. Identification of clones with resistance to prominent biotic stresses is likely to increase the chances of their adoption.

Postselection stage. Major bottlenecks are being identified in varietal registration process and production of sufficient planting material in advance of required for the national trials.

2.4.1 Genotyping of advanced population

To determine the disease-resistance ability at early stage, DNA isolates and dried leaves samples of the selected advanced clones from F_1C_2 generation were sent to HZPC, Holland. The clones were tested for their resistance ability against LB, cyst nematode, and PVY. A total of 23 advanced clones from Lots 1 and 2 and 2 CIP candidate clones were tested. The results have been shared with the TAP-5 team to be used for further selections (Annex 13).

2.4.2 Analysis of glycoalkaloid content of selected clones

Higher glycoalkaloid level in potato results in bitter taste and bad smell, and poses a threat to human health. Potato production in warmer areas tends to add in the glycoalkaloid concentration in tubers. A glycoalkaloid level below 20 mg/100 g fresh weight is considered acceptable if potato is cultivated under favorable conditions (to be on the safe side, for cultivation in warmer area, it should be less than 7 mg/100 g). To determine the glycoalkaloid content, freeze-dried samples of five selected clones (with sufficient tubers) were shipped to CIP–Lima's laboratory. All the tested clones were found to

have glycoalkaloid concentration significantly lower than the maximum acceptable limit and were in the safe range (Annex 13).

2.4.3 In vitro *multiplication of selected advanced clones*

In vitro multiplication of selected advanced clones is being carried out in laboratory at PVFC to keep readily available disease-free planting material for faster multiplication to conduct varietal release trials. The clones that are being discarded during further selections are also being removed from the *in vitro* multiplication. At present, 34 advanced clones and three local checks are under *in vitro* multiplication.

2.4.4 Gaining insight with the potato variety registration process

Efforts have been initiated to get familiar with the national variety release process, which is quite challenging. Some of these efforts include meeting with the national authority playing a vital role in the variety release process; discussion with the national partners to understand the trials' protocol; and organizing a workshop among the international stakeholders from HZPC, CIP, and SFSA.

Meeting with Dr. Tran Xuan Dinh, DDG, DCP. A meeting facilitated by Dr. Cuong (SFSA) was held with Dr. Dinh, Deputy Director General, Department of Crop Production (DCP), Ministry of Agriculture and Rural Development (MARD) in his office. The meeting was attended by Chien, Neeraj, and Dr. Cuong. A major discussion was to understand the variety release processes, the challenges associated, and the possible solutions to address these challenges. TAP-5 team requested Dr. Dinh to visit the trial site in Chuong My to observe the performance of the advanced clones in the field. It is important to mention here that the DCP is responsible for proposing clones to MARD for varietal registration and approval. Dr. Dinh and his team visited the trial in Choung My on February 2. From CIP, the visit was attended by Samarendu, Chien, and Neeraj.

Development of flowchart for variety release process. One summary flowchart (Annex 19) and one detailed flowchart have been prepared in discussion with DCP and national partners, including from FCRI and PVFC. The detailed flowchart clearly defines the process and the responsible institutes involved at each step, and is being used as a reference for the in-group discussion. All the possible steps to hasten the variety registration process are being identified in advance. Some of the trials of advanced clones are being carried out by following the protocol of national varietal release process to be better equipped with the procedure.

Workshop in Amsterdam. A workshop on marketing session for TAP-5 varieties was held on 12 October. One special session was allocated to the discussion on variety registration process. Rian Stekelenburg, from HZPC, presented on the time needed for the variety registration process in Vietnam, requirement of material, and bottlenecks in the whole approach. The presentation was followed by in-group discussion. The tasks and challenges in the process were identified, and participants were assigned the responsibilities of coming up with solutions.

2.5 MEETINGS AND WORKSHOP

Frequent planning, review, and update meetings were held in 2018. With each meeting, many suggestions were raised and improvements in the plan became a regular process.

2.5.1 Review and update meetings

- **April 23, Hanoi, Vietnam.** A meeting was held with Dr. Dao Xuan Cuong of SFSA in CIP–Hanoi office to update him about the progress of the TAP-5 project. The meeting was attended by Chien, Neeraj, and Samarendu (CIP's Asia regional director).

- **May 18, Cusco, Peru.** A midterm review meeting was organized alongside the World Potato Congress. The meeting was attended by Mike from SFSA; Robert from HZPC; and Oscar, Hugo, Walter, and Neeraj from CIP. During the meeting the progress of the TAP-5 project from October 2017 to May 2018 was reviewed, and stakeholders were updated about the activities that have been carried out during that period. Besides this, one agenda item was to discuss the possibilities of including advanced CIP clones in the TAP-5 project. On the basis of discussions among the participants, some important recommendations were made for further improvement.
- **September 12, Hanoi, Vietnam.** A review meeting was held with the participation of Herve Thieblemont, regional seed business development manager, SFSA. Neeraj, Marcel, Chien, Trang, and Samarendu from CIP–Hanoi also attended. Herve was updated about the project's progress. Samarendu presented CIP's operation and program in Vietnam; Chien presented the history of CIP in Vietnam and its role in potato research in Southeast Asia. Neeraj spoke on the background and latest status of the TAP-5 project. The meeting was followed by a long discussion on how to improve the access of the project's outcome to smallholder farmers, who constitute a major portion of the farming system in the region. The discussion continued further through email exchanges. It was suggested that national governments should be convinced to develop policies to promote value chains; smallholder farmers should be brought together for a viable business model; potato should be positioned as a high-value crop; potato production constraints in the region should be identified; and a platform should be developed to address these issues. A value chain analysis has been planned to streamline these proposals.

2.5.2 Strategic meetings to update time schedule based on selections

- **February meeting, Hanoi.** A strategic meeting in two sessions was held at CIP–Hanoi office after harvesting of the trials in Hai Duong and Dalat on 5 and 9 February. The meeting was attended by Chien, Walter, and Neeraj from CIP and Richard from HZPC. Minutes prepared based on the discussion were presented among the team members, including from HZPC, SFSA, and CIP in the Cusco meeting.
- **June 8, Hanoi, Vietnam.** The meeting was organized to discuss further about the selections made in Dalat during June at farmers' fields and screenhouse, respectively. Draft minutes of the Cusco meeting were also discussed to make the participants aware about the discussion held in the midterm review meeting at Cusco. A few points were further discussed for better implementation. A Gantt chart of the activities was updated as per the progress and planned trials (Annex 20).

2.5.3 Project workshop

- **October 12, Amsterdam.** A brainstorming session entitled "Bring TAP-5 varieties to market with a successful (sub) tropical global impact" was organized by HZPC. Participants from SFSA (Ian Barker); HZPC (Rian, Jan, Gert, Maurice, Richard, and Robert); and CIP (Hugo, Thiago, and Neeraj) attended. To stimulate better ideas on a successful market penetration, Nick from BoP Innovation Center (the invited speaker) delivered a special lecture. In the meeting, variety registration process and plant variety listing in Southeast Asia and Africa were discussed in detail. The scope of marketing sector for TAP-5 potential varieties was presented and discussed by Jan, sector manager-traditional market of HZPC. In the final session of the workshop, all the participants were divided into four groups to discuss the needs for route to market and their associated constraints. During compilation of the discussion, possible solutions were identified and tasks were assigned to the participants to manage these solutions.

2.6 IMPROVEMENTS

Continuous review and update meetings year-round resulted in many suggestions for improving the project's activities. Most of the ideas were generated due to the certain conditions, which were not apparent at the time the initial work plan was formulated. New challenges are coming up, as are new solutions. The following agreed deviations, or, more appropriately, "improvements," were included based on the field experiences:

- Southeast Asia has varied agro-ecologies and accordingly needs diverse range of genotypes. So it was decided that region-specific preferred-traits should be documented. Phenotyping of the selected clones needs to be done for different agro-ecologies to match the local requirements. The marketing team of HZPC is helping to identify the market-driven demands.
- Product profile was improved by adding more realistic values. Some of the traits were updated by putting digital scales for proper measurement and better comparison across the sites.
- Advanced CIP clones will be evaluated in parallel trials to test their candidature for TAP-5 project.
- Bacterial wilt is a serious threat in the targeted region. New population will be developed in Peru by crossing CIP and HZPC material. CIP has already identified material that possess BW resistance. Pollen will be dispatched from HZPC to carry out the crossing program.
- Tables have been installed in the BW-infested screenhouse at PVFC. The further trials and seed multiplications are being done in the pots by using clean media.

2.7 NETWORKING WITH THE LOCAL AUTHORITY

To improve the visibility in the region, attempts have been initiated to make the national authority in Vietnam aware of the project's goal, activities, and progress:

- Dr. Tran Xuan Dinh and his team from DCP, MARD, visited potato experiments in Chuong My, Hanoi. DCP is responsible for proposing MARD for crop variety registration and approval. From CIP, Samarendu Mohanty, the Asia regional director, also participated in the field visit.
- On 13 July 2018, a workshop on "CIP in Vietnam to Support MARD Agriculture Development Agenda" was organized in Hanoi by CIP and MARD jointly. A large number of participants from MARD, Department of Agriculture and Rural Development, leading and local private sectors, national potato research institutes, international organizations, the Food and Agriculture Organization of the United Nations, and others attended. Dr. Le Quoc Doanh, vice minister of MARD, and Dr. Barbara Wells, CIP's director general, were the chief guests. A special presentation was delivered for the TAP-5 project and its significance in Southeast Asia.

2.8 INSTITUTIONAL COMMITMENTS/AGREEMENTS

Two major agreements with the local partners in Vietnam have been renewed for "Collaboration on Breeding of Five Tropically Adapted Potato Varieties" between CIP–PVFC and CIP–FCRI.

The Potato, Vegetable and Flower Research Center is supporting implementation of trials in farmers' fields and at a screenhouse in Dalat. The institute is also maintaining the *in vitro* stock of selected advanced clones of the project.

FCRI is implementing trials in farmers' fields and at its campus in Hai Duong and Hai Phong in the RRD. The institute also received TS of new population on behalf of CIP for the project.

2.9 Facilities Developed

A weather station is installed at PVFC, Dalat, where maximum trials are being conducted. Two data loggers have been installed in a screenhouse to record relative humidity and temperature.

2.10 Main Learning Points

Most of the potato production areas in the RRD are severely affected by diseases and viruses. 'Atlantic', the most preferred local check, is not performing well in those biotic-stressed areas, clearly indicating its preferences for non-stressed areas. To evaluate next generations for more precise yield data in the RRD, trials will be conducted in Hai Phong—a popular site for commercial production of 'Atlantic'.

The cross combinations of some male parents were not successful, possibly because of a delay due to custom procedures. However, it somehow also showed that longevity of pollen viability is clone specific. It is important to explore the possibilities of how we can further reduce the shipment time to use the pollen viability of maximum clones more efficiently.

A detailed understanding of the potato variety registration process is critical to success.

3. FUTURE PLANS

- In addition to the regular field trials of TAP-5 material, we plan to add material resistance/ tolerance to BW in the existing lot. Identified BW-resistant CIP clones will be combined with HZPC germplasm in CIP's station at Huancayo, Peru. The evaluation will target those agro-ecologies where BW is considered a serious threat to potato production.
- The next annual review meeting will be held in Vietnam after the harvesting and evaluation of current field trials in February 2019. Participants from CIP, HZPC, and SFSA will attend.
- Regarding the expansion of the trials with promising clones in the neighboring countries in Southeast Asia, it is important to understand the process of distributing material to these countries and how to retain control over the distributed material.
- An explicit effort is needed to understand exactly the path to registration, and also formulate a plan to tackle the main registration bottlenecks to overcome during 2019.
  - A sub-proposal for a value chain analysis for potato will be drafted. Experts from CIP and SFSA will conduct the study in Vietnam by including inputs from HZPC. The propose of the study will be to:
  - Convince and facilitate national government to develop policies to promote value chains
  - Target smallholder farmers to have large impact by bringing them together for a viable business model
  - Position potato as a high value crop
  - Identify potato production constraints in the region and develop a platform to offer possible solutions

4. SITES FOR PLANTING POTATO EXPERIMENTS

Potato experiments were conducted in the following regions and sites.

4.1 RRD

- Hai Duong and Hai Phong (5–10 masl). The sites are around 120 km from Hanoi. Hai Phong is popular for commercial cultivation of local variety 'Atlantic' and provides favorable conditions for potato production during winter season.

4.2 CENTRAL HIGHLAND/TROPICAL HIGHLAND

- Dalat (1,500 masl) in Lam Dong Province of the central highland, 1,495 km from Hanoi, is a tropical highland potato-growing region. Owing to favorable conditions throughout the year, potato can be produced year-round.
- Sapa (1,581 masl), located in Lao Cai Province in the northwest, about 375 km from Hanoi, is a subtropical highland potato-growing region. It is also the site of the Potato Research Station (Potato Research Center) under the RCRDC, FCRI, Vietnamese Academy of Agricultural Sciences. The site is being considered for further evaluations.

ANNEXES

ANNEX 1: CIP PROGENITORS CONTRIBUTING TO TAP-5 HYBRID POPULATION AS FEMALE PARENTS

Sr No.	CIP Number	Code	Pedigree		Tuber Morphology				Resistance				Tolerance Abiotic	Processing Chip
			Female Parent	Male Parent	Skin color	Flesh color	Shape	Eye Depth	PVY	PVX	PLRV	LB	Heat /Drought	
1	CIP304349.25	LD-32.25	CHIEFTAIN	92.187	cream	white	oblong	Shallow	R			S	H,D	
2	CIP304369.22	LD-55.22	MARIELA	I.1039	cream	cream	round	Shallow	R			VS	H	
3	CIP304371.20	LD-57.20	MONALISA	92.187	cream	cream	oblong	Shallow	R			S	H	
4	CIP304371.67	LD-57.67	MONALISA	92.187	cream	cream	oblong	Shallow	R			S	H	
5	CIP304387.31	LD-73.31	REINHORT	92.187	cream	cream	round	Shallow	R			VS	H	
6	CIP304387.39	LD-73.39	REINHORT	92.187	cream	cream	oblong	Shallow	R			VS	H	
7	CIP304406.31	LD-93.31	WA.077	I.1039	cream	cream	round	Shallow	R			S	H	
8	CIP309003.13	VHT-003.013	C91.612	LD-73.17	cream	cream	long oblong	Shallow	R			MR	H	Good
9	CIP309036.108	VHT-036.108	WA.077/320.16	387170.9	cream	cream	round	Shallow	R				H	Good
10	CIP309043.123	VHT-043.123	317.6	CHIEFTAIN	white	white	long oblong	Shallow	R			R	H	
11	CIP309050.36	VHT-050.036	LD-88.108	LD-95.24	cream	cream	oblong	Shallow	R			MR	H, D	Good
12	CIP309076.59	VHT-076.059	LD-10.34	317.6	cream	cream	oblong	Shallow				MR	H	Good
13	CIP309093.43	VHT-093.043	LD-32.25	C93.154	cream	white	long oblong	Shallow	R			MR	H	
14	CIP309103.85	VHT-103.085	LD-32.8	ZAREVO	cream	cream	oblong	Shallow	R			MR	H	Good
15	CIP309121.6	VHT-121.006	LD-49.46	LD-39.32	cream	cream	oblong	Shallow	R			MR	H	Good
16	CIP309129.11	VHT-129.011	LD-52.46	LD-57.19	cream	cream	oblong	Shallow	R			MR	H	Good
17	CIP388615.22	C91.640	B-71-240.2	XY.16	cream	cream	round	Shallow	ER	ER	R		H	
18	CIP388676.1	Y84.027	378015.18	PVY-BK	cream	white	round	Shallow	ER			MR	H	Excellent
19	CIP390478.9	C90.170	SERRANA	XY.4	cream	cream	round	Shallow	ER	ER			H	
20	CIP392820.1	C93.154	MONALISA	YY-5	cream	cream	oblong	Shallow	ER	ER	R		H	
21	CIP397006.18	102.18	92.119	88.052	cream	cream	round	Shallow	ER	ER			H, D	
22	CIP397036.7	427.7	LR93.160	92.187	cream	cream	oblong	Shallow		ER	MR		H	
23	CIP397069.11	233.11	C92.140	C93.154	cream	yellow	oblong	Shallow	R	R	MR		H	
24	CIP397077.16	WA.077/320.16	LR93.221	C93.154	cream	cream	oblong	Shallow	ER	ER	S		H, D	
25	CIP397079.6	317.6	MARIA TAMBEÑA	C93.154	cream	cream	oblong	Shallow	ER		R		H	
26	CIP398180.292		392657.171	392633.64	cream	cream	oblong	Shallow	R		R	R		
27	CIP398201.510		393242.50	392633.64	Pink	cream	oblong	Shallow				R		
28	CIP398208.505		393371.58	392633.64	cream	cream	oblong	Shallow	R	R	R	R	H	
29	CIP398208.620		393371.58	392633.64	cream	cream	elliptic	Shallow				R		
30	CIP398208.670		393371.58	392633.64	cream	cream	oblong	Shallow	R	R	R	R	H	

R: Resistant, ER: Extremely Resistant, MR: Moderately Resistant, S: Susceptible; VS: Very Susceptible, H: Heat, D: Drought

ANNEX 2: HZPC PROGENITORS CONTRIBUTING TO TAP-5 HYBRID POPULATION AS MALE PARENTS

	Tube Code	Progenitor	# Tubes	Type G=Granola, A=Atlantic	Resistances Nematodes / Blight	Relative Yield	Maturity 40-90	Dormancy Period 10-90	Tuber Size 90 = 70 Mm+	Shape	Flesh Color	Skin Color	Overall Impression	DM%	Cooking Type	Second Fry 10-90	Crisps 10-90	Late Blight Foliage 10-90
1	HCIP 7007	HOM 13-8226	3	G	G. rost.1 + blight !	123	55	67	67	OLO	Y	Y	68	19.5	firm-bit mealy	57	43	99
2	RHT 06- 25	HCIP 7026																
3	HCIP 7008	HOM 13-8236	2	A/G	G. rost.1 + blight !	125	68	58	82	O	LY	DY	66	22.7	mealy	74	63	97
4	HCIP 7028	BIJ 11- 17	2	G	G. rost.1	108	77	77	86	O	Y	Y	72	19.4	firm-bit mealy	55		40
5	HCIP 7029	HZA 11-3013	2	G	G. rost.1	115	83	56	81	O	LY	Y	70	16.9	firm	52		40
6	HCIP 7032	VR 808	3	A	G. rost.1	96	62	89	79	RO	Y	DY	66	24.5	mealy	77	71	38
7	HOT 06-7231	HCIP 7065																
8	HCIP 7070	HOM 14-8046	2	A	G. pallida + blight	86	65	79	72	RRO	LY	Y	63	21.9	firm-bit mealy	69	80	99
9	HCIP 8051	HO 11-8336	2	G	susc	82	56	27	63	OLO	DY	Y	65	20.5	bit mealy	57	45	34

LO = long oval, OLO = oval-long-oval, O = oval, ROO = oval - round-oval, RRO = round - round-oval, Y = yellow, LY = light-yellow, CR = crème

ANNEX 3: CIP–HZPC CROSS-COMBINATIONS RECEIVED DURING 2018 IN TWO CONSIGNMENTS

S. No.	Family	Female Accession Number	Female Breeder Code	Male Accession Number	Male Breeder Code	No. of Seeds Received
1	HCIP317040	CIP304369.22	LD-55.22	VR 808	HCIP 7032	300
2	HCIP317041	CIP304369.22	LD-55.22	HO 11-8336	HCIP 8051	300
3	HCIP317044	CIP392820.1	C93.154	HOM 13-8226	HCIP 7007	100
4	HCIP317050	CIP397006.18	102.18	HZA 11-3013	HCIP 7029	100
5	HCIP317055	CIP309003.13	VHT-003.013	VR 808	HCIP 7032	60
6	HCIP317062	CIP388615.22	C91.640	HO 11-8336	HCIP 8051	300
7	HCIP317066	CIP388676.1	Y84.027	VR 808	HCIP 7032	300
8	HCIP317067	CIP309003.13	VHT-003.013	HO 11-8336	HCIP 8051	300
9	HCIP317078	CIP309121.6	VHT-121.006	HO 11-8336	HCIP 8051	200
10	HCIP317079	CIP309129.11	VHT-129.011	HO 11-8336	HCIP 8051	300
11	HCIP317084	CIP397077.16	WA.077/320.16	HOM 13-8226	HCIP 7007	100
12	HCIP317089	CIP304369.22	LD-55.22	BIJ 11- 17	HCIP 7028	57
13	HCIP317092	CIP397079.6	317.6	HOM 13-8236	HCIP 7008	300
14	HCIP317097	CIP390478.9	C90.170	VR 808	HCIP 7032	300
15	HCIP317098	CIP304387.39	LD-73.39	HO 11-8336	HCIP 8051	300
16	HCIP317099	CIP304387.39	LD-73.39	BIJ 11- 17	HCIP 7028	100
17	HCIP317103	CIP304387.31	LD-73.31	HO 11-8336	HCIP 8051	300
18	HCIP317105	CIP397077.16	WA.077/320.16	VR 808	HCIP 7032	300
19	HCIP317106	CIP397079.6	317.6	VR 808	HCIP 7032	300
20	HCIP317116	CIP392820.1	C93.154	HOM 13-8236	HCIP 7008	300
21	HCIP317118	CIP388676.1	Maria Bonita	BIJ 11- 17	HCIP 7028	100
22	HCIP317119	CIP390478.9	Tacna	BIJ 11- 17	HCIP 7028	43
23	HCIP317120	CIP388676.1	Y84.027	HO 11-8336	HCIP 8051	300
24	HCIP317122	CIP392820.1	C93.154	HO 11-8336	HCIP 8051	200
25	HCIP317127	CIP390478.9	C90.170	HO 11-8336	HCIP 8051	300
26	HCIP317129	CIP397006.18	102.18	HO 11-8336	HCIP 8051	300
27	HCIP317131	CIP397077.16	WA.077/320.16	HO 11-8336	HCIP 8051	300
28	HCIP317134	CIP398201.510		HO 11-8336	HCIP 8051	300
29	HCIP317152	CIP309043.123	VHT-043.123	HO 11-8336	HCIP 8051	300
30	HCIP317154	CIP309050.36	VHT-050.036	HO 11-8336	HCIP 8051	300
31	HCIP317157	CIP397079.6	317.6	HO 11-8336	HCIP 8051	300
32	HCIP317162	CIP304406.31	LD-93.31	HO 11-8336	HCIP 8051	300
33	HCIP317165	CIP309129.11	VHT-129.011	VR 808	HCIP 7032	300
34	HCIP317169	CIP398208.620		HO 11-8336	HCIP 8051	300
35	HCIP317170	CIP397006.18	102.18	HOM 13-8226	HCIP 7007	100
36	HCIP317173	CIP397079.6	317.6	HOM 14-8046	HCIP 7070	63
37	HCIP317176	CIP309093.43	VHT-093.043	HOM 13-8236	HCIP 7008	250
38	HCIP317180	CIP398208.620		HOM 13-8236	HCIP 7008	300
39	HCIP317185	CIP304369.22	LD-55.22	HOM 13-8226	HCIP 7007	45
40	HCIP317187	CIP304371.67	LD-57.67	HO 11-8336	HCIP 8051	300
41	HCIP317191	CIP304387.39	LD-73.39	HOM 13-8226	HCIP 7007	40
42	HCIP317195	CIP390478.9	C90.170	HOM 13-8226	HCIP 7007	46
43	HCIP317198	CIP397079.6	317.6	HOM 13-8226	HCIP 7007	100
44	HCIP317205	CIP398208.670		HOM 13-8226	HCIP 7007	45
45	HCIP317212	CIP388615.22	C91.640	HOM 13-8226	HCIP 7007	90
46	HCIP317213	CIP388676.1	Maria Bonita	HOM 13-8226	HCIP 7007	100
47	HCIP317215	CIP309103.85	VHT-103.085	VR 808	HCIP 7032	300
48	HCIP317216	CIP392820.1	C93.154	VR 808	HCIP 7032	300
49	HCIP317218	CIP304349.25	LD-32.25	HO 11-8336	HCIP 8051	300
50	HCIP317219	CIP309103.85	VHT-103.085	HO 11-8336	HCIP 8051	300

S. No.	Family	Female Accession Number	Female Breeder Code	Male Accession Number	Male Breeder Code	No. of Seeds Received
51	HCIP317220	CIP304349.25	LD-32.25	VR 808	HCIP 7032	300
52	HCIP317221	CIP304371.20	LD-57.20	VR 808	HCIP 7032	300
53	HCIP317222	CIP388615.22	C91.640	VR 808	HCIP 7032	300
54	HCIP317223	CIP397006.18	102.18	VR 808	HCIP 7032	300
55	HCIP317224	CIP398201.510		VR 808	HCIP 7032	300
56	HCIP317230	CIP397006.18	102.18	HOM 13-8236	HCIP 7008	300
57	HCIP317231	CIP397077.16	WA.077/320.16	HOM 13-8236	HCIP 7008	300
58	HCIP317232	CIP398208.670		VR 808	HCIP 7032	300
59	HCIP317241	CIP397006.18	102.18	BIJ 11- 17	HCIP 7028	100
60	HCIP317244	CIP398208.670		HO 11-8336	HCIP 8051	300
61	HCIP317245	CIP304387.39	LD-73.39	VR 808	HCIP 7032	300
62	HCIP317071	CIP309121.6	VHT-121.006	BIJ 11- 17	HCIP 7028	50
63	HCIP317137	CIP309093.43	VHT-093.043	VR 808	HCIP 7032	115
64	HCIP317209	CIP398208.505		HO 11-8336	HCIP 8051	125
65	HCIP317161	CIP304371.20	LD-57.20	HO 11-8336	HCIP 8051	130
66	HCIP317072	CIP392820.1	C93.154	BIJ 11- 17	HCIP 7028	170
67	HCIP317228	CIP309076.59	VHT-076.059	HOM 13-8236	HCIP 7008	202
68	HCIP317217	CIP304371.67	LD-57.67	VR 808	HCIP 7032	235
69	HCIP317048	CIP304369.22	LD-55.22	HOM 13-8236	HCIP 7008	250
70	HCIP317108	CIP398208.670		HOM 13-8236	HCIP 7008	250
71	HCIP317111	CIP304406.31	LD-93.31	HOM 13-8236	HCIP 7008	250
72	HCIP317126	CIP388615.22	C91.640	HOM 13-8236	HCIP 7008	250
73	HCIP317128	CIP390478.9	C90.170	HOM 13-8236	HCIP 7008	250
74	HCIP317175	CIP309043.123	VHT-043.123	HOM 13-8236	HCIP 7008	250
75	HCIP317177	CIP309129.11	VHT-129.011	HOM 13-8236	HCIP 7008	250
76	HCIP317178	CIP388676.1	Maria Bonita	HOM 13-8236	HCIP 7008	250
77	HCIP317179	CIP398180.292		HOM 13-8236	HCIP 7008	250
78	HCIP317181	CIP398208.505		VR 808	HCIP 7032	250
79	HCIP317225	CIP304349.25	LD-32.25	HOM 13-8236	HCIP 7008	250
80	HCIP317226	CIP304371.20	LD-57.20	HOM 13-8236	HCIP 7008	250
81	HCIP317227	CIP304387.39	LD-73.39	HOM 13-8236	HCIP 7008	250
82	HCIP317229	CIP309121.6	VHT-121.006	HOM 13-8236	HCIP 7008	250
83	HCIP317240	CIP309043.123	VHT-043.123	VR 808	HCIP 7032	250
	Total					**18816**

ANNEX 4: SELECTIONS' PROGRESS UNDER SCHEME 1 IN DALAT

Sr No.	TS family	Plants survived in Sept. 2016	February 2017 at F_1	October 2017 at F_1C_1	June 2018, at F_1C_2 in Farmers' Fields
1	HCIP316002	14			
2	HCIP316007	18	6		
3	HCIP316008	11	2		
4	HCIP316009	16	2		
5	HCIP316013	14	3		
6	HCIP316014	6			
7	HCIP316018	12	1		
8	HCIP316019	7			
9	HCIP316020	22	6		
10	HCIP316039	7			
11	HCIP316040	12	2		
12	HCIP316041	25	4		
13	HCIP316049	26	5		
14	HCIP316050	5			
15	HCIP316053	22	4		
16	HCIP316054	17	1		
17	HCIP316055	27	1		
18	HCIP316056	25	5	1	1
19	HCIP316057	43	13		
20	HCIP316062	31	1		
21	HCIP316063	67	6		
22	HCIP316064	52	3		
23	HCIP316069	28	3		
24	HCIP316073	28			
25	HCIP316074	25	3		
26	HCIP316075	42	1		
27	HCIP316079	21			
28	HCIP316080	17			
29	HCIP316083	28	2		
30	HCIP316084	33	4		
31	HCIP316085	23	4		
32	HCIP316094	28	2		
33	HCIP316095	42	2		
34	HCIP316100	20	3		
35	HCIP316101	8			
36	HCIP316102	25	2		
37	HCIP316103	25	3		
38	HCIP316121	81	21	1	1
39	HCIP316125	31	4		
40	HCIP316126	27	4		
41	HCIP316127	11	1		
42	HCIP316132	20	6	1	1
43	HCIP316136	27	4	2	1
44	HCIP316140	11	1		
45	HCIP316147	17	9	1	1
46	HCIP316148	30	7		
47	HCIP316153	70	7		
48	HCIP316163	17	9	2	1
49	HCIP316169	12			
50	HCIP316170	12	14	1	
51	HCIP316172	22	1		
52	HCIP316173	22	8	1	
53	HCIP316174	50	8		
54	HCIP316175	51	7		
55	HCIP316177	3			
Total		**1,386**	**205**	**10**	**6**

ANNEX 5: SELECTIONS' PROGRESS UNDER SCHEME 2 (64 FAMILIES)

Sr No	TS Family	Hai Duong		Dalat	Hai Duong	Dalat at Farmers' Field
		TPS Sept., 2016	March, 2017 at F_1 stage	July-October, 2017 at F_1C_1 stage	November 2017-February, 2018 at F_1C_1 stage	March-June, 18 at F_1C_2 stage
1	HCIP316003	70	3			
2	HCIP316006	100				
3	HCIP316015	80				
4	HCIP316017	40				
5	HCIP316021	40	5			
6	HCIP316023	100				
7	HCIP316026	50				
8	HCIP316027	80	10	1	2	1
9	HCIP316028	120	3			
10	HCIP316033	100				
11	HCIP316034	40	16		1	
12	HCIP316035	40				
13	HCIP316038	40	4		1	
14	HCIP316044	120				
15	HCIP316045	120	12	1		1
16	HCIP316052	70				
17	HCIP316060	50				
18	HCIP316066	90				
19	HCIP316067	50	5			
20	HCIP316068	120	4			
21	HCIP316070	80	3			
22	HCIP316078	120	13	2		1
23	HCIP316087	120				
24	HCIP316088	120	4			
25	HCIP316091	100				
26	HCIP316092	120				
27	HCIP316093	100	13			
28	HCIP316097	120				
29	HCIP316098	70				
30	HCIP316099	50	11		2	
31	HCIP316106	120				
32	HCIP316107	80				
33	HCIP316110	120	3			
34	HCIP316111	120	4		1	
35	HCIP316115	80				
36	HCIP316116	80	3		2	
37	HCIP316117	120	4			
38	HCIP316118	120	4			
39	HCIP316120	120	9			
40	HCIP316122	120				
41	HCIP316123	80				
42	HCIP316124	40				
43	HCIP316130	40				
44	HCIP316131	80				
45	HCIP316133	80				
46	HCIP316135	120				
47	HCIP316138	70				
48	HCIP316141	80				

Sr No	TS Family	Hai Duong		Dalat	Hai Duong	Dalat at Farmers' Field
		TPS Sept., 2016	March, 2017 at F_1 stage	July-October, 2017 at F_1C_1 stage	November 2017-February, 2018 at F_1C_1 stage	March-June, 18 at F_1C_2 stage
49	HCIP316142	60				
50	HCIP316144	120	8		2	
51	HCIP316145	40				
52	HCIP316146	40				
53	HCIP316151	120				
54	HCIP316154	80				
55	HCIP316155	100	3			
56	HCIP316156	120				
57	HCIP316157	120				
58	HCIP316158	100				
59	HCIP316159	50				
60	HCIP316164	120				
61	HCIP316165	40				
62	HCIP316166	120	6			
63	HCIP316171	100				
64	HCIP316178	120	3			
Total		**5,640**	**153**	**4**	**11**	**3**

ANNEX 6: SELECTIONS' PROGRESS UNDER SCHEME 2 (55 FAMILIES)

Sr No	TS Family	Hai Duong		Dalat	Hai Duong	Dalat at Farmer Field
		TPS	March, 2017 at F_1 stage	July-October, 2017 at F_1C_1 stage	November 2017-February, 2018 at F_1C_1 stage	March-June, 18 at F_1C_2 stage
1	HCIP316002	120	8			
2	HCIP316007	120				
3	HCIP316008	120	2			
4	HCIP316009	120	7		3	
5	HCIP316013	100				
6	HCIP316014	120				
7	HCIP316018	100				
8	HCIP316019	100				
9	HCIP316020	120	4			
10	HCIP316039	120				
11	HCIP316040	120	4		1	
12	HCIP316041	120	10		4	
13	HCIP316049	120	4		1	
14	HCIP316050	120	3			
15	HCIP316053	120	15			
16	HCIP316054	120	12			
17	HCIP316055	120	12		2	
18	HCIP316056	120	28	1	7	
19	HCIP316057	120	4			
20	HCIP316062	120				
21	HCIP316063	120	8	1	1	
22	HCIP316064	120	7		1	
23	HCIP316069	120	10	2		1
24	HCIP316073	120	8			
25	HCIP316074	120				
26	HCIP316075	120				
27	HCIP316079	120	6	2		1
28	HCIP316080	120	5			
29	HCIP316083	120				
30	HCIP316084	120	13			
31	HCIP316085	120	25			
32	HCIP316094	120	3			
33	HCIP316095	120	18		1	
34	HCIP316100	120	2			
35	HCIP316101	120				
36	HCIP316102	120	17		2	
37	HCIP316103	120	1			
38	HCIP316121	120	5			
39	HCIP316125	100	5		1	
40	HCIP316126	120	3		1	
41	HCIP316127	120				
42	HCIP316132	120	7		1	
43	HCIP316136	120	3			
44	HCIP316140	120	20	3	4	2
45	HCIP316147	120	3			
46	HCIP316148	120	21		1	
47	HCIP316153	120				
48	HCIP316163	120	9			

Sr No	TS Family	Hai Duong		Dalat	Hai Duong	Dalat at Farmer Field
		TPS	March, 2017 at F_1 stage	July-October, 2017 at F_1C_1 stage	November 2017-February, 2018 at F_1C_1 stage	March-June, 18 at F_1C_2 stage
49	HCIP316169	120	6		2	
50	HCIP316170	120	7		1	
51	HCIP316172	120	8		3	
52	HCIP316173	120				
53	HCIP316174	120	3		2	
54	HCIP316175	120	7		1	
55	HCIP316177	120				
Total		**6,520**	**343**	**9**	**40**	**4**

ANNEX 7: SELECTIONS' PROGRESS UNDER SCHEME 3 (49 FAMILIES) IN DALAT

Sr No	TS family	Survived plants in June 2017	October 2017 at F_1 stage	March-June, 2018 at F_1C_1 stage
1	HCIP316002	123	5	
2	HCIP316007	140	3	1
3	HCIP316008	60	2	
4	HCIP316009	130	7	2
5	HCIP316014	120	4	2
6	HCIP316020	120	4	1
7	HCIP316039	94	6	2
8	HCIP316040	114	8	5
9	HCIP316041	130	4	2
10	HCIP316049	135	3	1
11	HCIP316050	96	4	1
12	HCIP316053	115	1	
13	HCIP316054	42	6	1
14	HCIP316055	120	5	2
15	HCIP316056	151	4	
16	HCIP316057	96		
17	HCIP316062	162	6	
18	HCIP316063	177	5	4
19	HCIP316064	171	4	2
20	HCIP316069	160	6	1
21	HCIP316073	60	6	1
22	HCIP316074	156	4	1
23	HCIP316075	120		
24	HCIP316079	130	5	2
25	HCIP316080	140	1	
26	HCIP316083	130	1	
27	HCIP316084	67	2	
28	HCIP316094	62	2	
29	HCIP316095	63	1	
30	HCIP316100	62	2	
31	HCIP316101	125	6	
32	HCIP316102	130	12	
33	HCIP316103	91	2	1
34	HCIP316121	115	4	2
35	HCIP316126	130	3	
36	HCIP316132	100	11	5
37	HCIP316136	50	3	1
38	HCIP316140	120	11	4
39	HCIP316147	110	4	4
40	HCIP316148	110	2	1
41	HCIP316153	57	1	
42	HCIP316163	125	4	1
43	HCIP316169	98	8	2
44	HCIP316170	100	6	5
45	HCIP316172	120	6	1
46	HCIP316173	124	3	2
47	HCIP316174	112	11	2
48	HCIP316175	141	3	2
49	HCIP316177	96	13	6
	Total	**5,500**	**224**	**70**

ANNEX 8: PERFORMANCE OF SELECTED CLONES AT F1C1 STAGE IN HAI DUONG, FCRI HARVESTED IN FEBRUARY 2018

Sr No.	Clone	Plants/ plot	Wt. of total tubers (g/plot)	Total tubers/ plot	´Tuber appearance (1: poorest, 9=best)	´Tuber Uniformity (1:poorest, 9=best)	´Tuber Size (1:smallest, 9=largest)	Tuber Brightness (1:poorest, 9=best)	Av tuber weight (g)	Calculated yield (t/ha)
1	HCIP316009.202	4	930	18	7	8	5	7	51.7	11.6
2	HCIP316009.203	4	700	15	6	6	5	6	46.7	8.8
3	HCIP316009.207	3	820	15	6	7	5	7	54.7	13.7
4	HCIP316027.106	6	1300	20	6	6	5	6	65.0	10.8
5	HCIP316027.110	3	700	11	5	6	5	6	63.6	11.7
6	HCIP316034.105	6	1100	21	7	6	6	7	52.4	9.2
7	HCIP316038.101	4	1200	27	6	6	5	7	44.4	15.0
8	HCIP316040.203	3	700	13	7	6	7	8	53.8	11.7
9	HCIP316041.201	9	1300	25	7	5	5	6	52.0	7.2
10	HCIP316041.202	6	1000	22	8	7	6	8	45.5	8.3
11	HCIP316041.203	6	1450	27	6	7	5	8	53.7	12.1
12	HCIP316041.205	3	650	10	7	7	6	8	65.0	10.8
13	HCIP316049.202	6	1450	26	7	6	7	7	55.8	12.1
14	HCIP316055.210	3	1300	23	6	6	5	8	56.5	21.7
15	HCIP316055.212	3	800	18	6	6	4	7	44.4	13.3
16	HCIP316056.201	5	1300	16	7	7	7	7	81.3	13.0
17	HCIP316056.202	4	800	20	6	6	4	7	40.0	10.0
18	HCIP316056.205	3	700	12	5	6	5	6	58.3	11.7
19	HCIP316056.207	4	1550	14	7	7	6	8	110.7	19.4
20	HCIP316056.222	3	1400	12	6	6	8	6	116.7	23.3
21	HCIP316056.223	4	700	14	7	6	5	7	50.0	8.8
22	HCIP316056.226	3	900	15	7	7	6	8	60.0	15.0
23	HCIP316063.203	9	2100	46	7	7	6	8	45.7	11.7
24	HCIP316064.204	3	1350	26	6	6	6	8	51.9	22.5
25	HCIP316095.211	4	900	19	7	8	5	7	47.4	11.3
26	HCIP316099.104	5	700	18	6	5	5	7	38.9	7.0
27	HCIP316099.108	6	1300	27	5	4	4	7	48.1	10.8
28	HCIP316102.208	6	950	14	8	7	6	7	67.9	7.9
29	HCIP316102.210	3	500	15	6	6	5	7	33.3	8.3
30	HCIP316111.104	3	1000	17	7	8	5	7	58.8	16.7
31	HCIP316116.102	3	1200	14	7	7	7	6	85.7	20.0
32	HCIP316116.103	9	1500	30	6	5	5	6	50.0	8.3
33	HCIP316125.203	11	1730	52	6	6	4	8	33.3	7.9
34	HCIP316126.202	4	1100	20	8	8	5	7	55.0	13.8
35	HCIP316132.207	3	830	20	6	6	5	8	41.5	13.8
36	HCIP316140.203	4	950	13	6	7	6	6	73.1	11.9
37	HCIP316140.208	4	550	14	6	6	5	6	39.3	6.9
38	HCIP316140.211	4	1000	13	7	7	7	7	76.9	12.5
39	HCIP316140.214	4	800	24	5	5	4	6	33.3	10.0
40	HCIP316144.105	7	1300	26	5	6	5	7	50.0	9.3
41	HCIP316144.108	5	1500	18	6	6	7	7	83.3	15.0
42	HCIP316148.209	4	1000	24	7	6	5	6	41.7	12.5
43	HCIP316169.202	4	1200	24	6	5	5	7	50.0	15.0
44	HCIP316169.205	4	1500	30	6	7	7	8	50.0	18.8
45	HCIP316170.202	8	1700	35	6	6	7	8	48.6	10.6

Sr No.	Clone	Plants/ plot	Wt. of total tubers (g/plot)	Total tubers/ plot	´Tuber appearance (1: poorest, 9=best)	´Tuber Uniformity (1:poorest, 9=best)	´Tuber Size (1:smallest, 9=largest)	Tuber Brightness (1:poorest, 9=best)	Av tuber weight (g)	Calculated yield (t/ha)
46	HCIP316172.202	4	750	17	6	6	5	7	44.1	9.4
47	HCIP316172.206	6	1520	28	7	7	7	6	54.3	12.7
48	HCIP316172.208	4	750	12	7	7	5	7	62.5	9.4
49	HCIP316174.201	3	900	20	7	6	5	7	45.0	15.0
50	HCIP316174.202	4	1120	22	7	5	6	8	50.9	14.0
51	HCIP316175.205	4	800	22	7	6	6	7	36.4	10.0
52	Atlantic	6	1025	14.0	6.0	6.3	6.3	6.0	73.2	8.5
53	Marabel	6	908	19.3	5.8	5.8	5.2	6.5	47.0	7.6
54	Solara	6	792	23.0	4.8	5.3	4.0	6.3	34.4	6.6

ANNEX 9: GROWTH TRAITS OF THE EVALUATED CLONES AT FARMERS' FIELDS IN DALAT FROM MARCH TO JUNE 2018

Sr No.	Genotype	Plant Vigor (1=very weak, 9= very vigorous) mode	Senescence at 75 days (1=very late, 7=earliest) mode	Plant growth habit (1= erect, 2= semi-erect, 3 = decumbent)	Leaf type (1= Ugly, 2= acceptable, 3= very good) mode	Stem number per plant
1	HCIP316027.101	7	3, 5, 7	3	3	2.50
2	HCIP316056.103	9	3	3	2	2.53
3	HCIP316069.202	7	3	3	2	3.57
4	HCIP316069.204	7	7	3	2	1.93
5	HCIP316078.106	7	5	3	3	3.25
6	HCIP316121.108	7	3	3	1	2.60
7	HCIP316132.106	5	5	3	2	2.27
8	HCIP316136.101	7	1	1	2	2.60
9	HCIP316136.103	7	1	3	2	3.73
10	HCIP316140.210	9	3	3	3	2.60
11	HCIP316140.214	7	3	3	2	2.33
12	HCIP316147.109	5	5	3	2	2.32
13	HCIP316163.101	5, 7, 9	5	3	1, 2, 3	3.53
14	HCIP316163.107	7	3	3	2	1.33
15	HCIP316170.103	5	3	3	2	3.10
16	HCIP316173.107	1, 3, 7	1	1	3	1.28
17	Atlantic	3, 5, 7	7	1	3	2.32
18	Solara	5	7	3	2	1.70

ANNEX 10: TUBERS TRAITS OF THE EVALUATED CLONES AT FARMERS' FIELDS IN DALAT FROM MARCH TO JUNE 2018

Sr No	Genotype	Tuber skin color (White=1, Yellow=2, Orange=3, Brownish=4) mode	Tuber flesh color (White=1, Cream=2, Pale yellow=3, Yellow=4) mode	Tuber shape (Compressed=1, Rounded=2, Ovoid=3, Obovoid=4,) mode	Tuber eye depth (Protruding=1, Shallow=3, Slightly deep=5, Deep=7) mode	Tuber appearance (1=Poorest, 7=Best) mode	Tuber uniformity (1=Poorest, 7=Best) mode	Tuber Size (1=Small, 7=Large) mode
1	HCIP316027.101	2	4	3	3	7	7	7
2	HCIP316056.103	2	4	2	3	7	7	7
3	HCIP316069.202	1	1	3	3	3, 5, 7	3, 5, 7	5
4	HCIP316069.204	2	4	3	3	7	7	7
5	HCIP316078.106	2	4	3	3	7	7	7
6	HCIP316121.108	1	1	3	3	7	7	7
7	HCIP316132.106	2	4	3	3	7	7	3, 5, 7
8	HCIP316136.101	1	1	2	3	3, 5, 7	3, 5, 7	3, 5, 7
9	HCIP316136.103	1	1	3	5	7	5	7
10	HCIP316140.210	1	1	2	3	7	7	7
11	HCIP316140.214	2	4	3	3	7	7	5
12	HCIP316147.109	2	4	2	3	7	7	7
13	HCIP316163.101	1	1	3	3	7	7	7
14	HCIP316163.107	2	4	2	5	5	5	3, 5, 7
15	HCIP316170.103	2	2, 3, 4	2	3	5	5	5
16	HCIP316173.107	2	4	2	3	3	5	5
17	Atlantic	1	1	2	3	7	7	5
18	Solara	2	4	3	3	7	7	5

ANNEX 11: YIELD AND RELATED TRAITS OF THE SELECTED CLONES AT FARMER'S FIELD IN DALAT EVALUATED FROM MARCH TO JUNE 2018

Sr No	Genotype	No of marketable tubers/ plant	Total tubers/ plant	Marketable tuber weight/plant (kg)	Marketable tuber yield (t/ha)	Average of marketable tuber weight (g)	Average of tuber weight (g)	Total tuber weight/ plant (kg)	Total tuber yield (t/ha)
1	HCIP316027.101	3.24	4.94	0.47	23.5	145.9	107.6	0.538	26.9
2	HCIP316056.103	3.00	5.70	0.34	17.0	113.7	82.5	0.460	23.0
3	HCIP316069.202	4.18	9.27	0.42	20.8	99.9	64.9	0.597	29.8
4	HCIP316069.204	3.49	4.92	0.41	20.4	116.8	90.0	0.446	22.3
5	HCIP316078.106	1.55	2.30	0.28	13.9	176.7	128.7	0.306	15.3
6	HCIP316121.108	3.78	4.87	0.73	36.5	192.0	159.0	0.768	38.4
7	HCIP316132.106	2.12	6.48	0.19	9.5	91.7	48.7	0.324	16.2
8	HCIP316136.101	2.32	5.78	0.25	12.4	113.5	86.9	0.350	17.5
9	HCIP316136.103	3.20	6.80	0.41	20.7	154.2	78.2	0.530	26.5
10	HCIP316140.210	4.73	6.20	0.70	35.0	141.7	121.2	0.760	38.0
11	HCIP316140.214	4.65	9.03	0.45	22.3	95.3	66.9	0.563	28.2
12	HCIP316147.109	4.08	5.94	0.47	23.3	135.9	98.9	0.536	26.8
13	HCIP316163.101	4.57	6.30	0.42	20.9	89.7	76.3	0.486	24.3
14	HCIP316163.107	2.17	4.82	0.33	16.4	152.5	81.8	0.383	19.2
15	HCIP316170.103	2.01	7.02	0.21	10.7	104.2	53.8	0.358	17.9
16	HCIP316173.107	1.25	4.08	0.10	5.0	83.3	50.4	0.179	9.0
17	Atlantic	2.67	3.92	0.26	13.1	99.1	81.1	0.313	15.6
18	Solara	1.94	4.89	0.17	8.4	87.3	52.0	0.263	13.2
	SD	0.84	1.32	0.14	7.08	26.6	25.3	0.13	6.65
	Variance	0.71	1.75	0.02	50.2	706.4	640.1	0.02	44.2
	SE	0.74	1.055	0.897	4.483	18.603	15.364	0.909	4.547
	CD	2.13	3.03	0.26	12.89	53.47	44.15	0.26	13.07
	CV (%)	42.0	31.9	42.4	42.4	26.4	31.3	34.8	34.8

ANNEX 12: PERFORMANCE OF SELECTED CLONES FOR PROCESSING AND RELATED TRAITS AT FARMERS' FIELDS IN DALAT EVALUATED FROM MARCH TO JUNE 2018

Sr No.	Genotype	DM (%)	Reducing sugar (%)	Chips Color (1=best, 5=poorest)	French Fry Score (1=best, 5=poorest)	Boiling (1= poorest, 9= best)
1	HCIP316027.101	16.5	0.25	2.89	3.44	6.08
2	HCIP316056.103	22.9	0.27	3.33	3.22	5.17
3	HCIP316069.204	18.4	0.22	3.22	3.33	4.67
4	HCIP316078.106	19.9	0.30	2.22	2.44	6.08
5	HCIP316121.108	16.1	0.31	2.56	2.78	5.17
6	HCIP316132.106	13.8	0.28	3.67	3.67	5.08
7	HCIP316136.101	15.8	0.29	4.00	3.78	5.75
8	HCIP316140.210	15.2	0.37	3.33	3.78	6.33
9	HCIP316140.214	16.2	0.37	4.44	3.44	6.25
10	HCIP316147.109	18.1	0.22	3.56	3.56	6.67
11	HCIP316163.101	16.9	0.32	4.22	4.33	7.00
12	Atlantic	20.0	0.32	1.78	1.56	5.92
13	Solara	19.2	0.29	2.89	2.89	7.83

ANNEX 13: DNA ANALYSIS OF SELECTED CLONES AND GLYCOALKALOID CONTENT OF CLONES WITH SUFFICIENT TUBERS EVALUATED AT FARMERS' FIELDS IN DALAT FROM MARCH TO JUNE 2018

Sr No.	Genotype	M3 (LB)	M7 (PCN)	M8 (LB)	M21 (LB)	M27 (PVY)	Glycoalkaloid (mg/100g DW)	Glycoalkaloid (mg/100 g FW)
1	HCIP316136.103	0	0	0	0	0		
2	HCIP316045.103	0	1	0	0	1		
3	HCIP316140.210	1	1	0	0	1	8.75	1.33
4	HCIP316056.220	1	1	0	0	1		
5	HCIP316132.106	0	1	0	0	0		
6	HCIP316140.214	0	0	0	0	0	10.86	1.76
7	HCIP316136.101	0	0	0	0	0		
8	HCIP316163.101	1	0	0	0	0		
9	HCIP316027.101	1	1	0	0	0	2.62	0.43
10	HCIP316069.202	1	1	0	0	1		
11	HCIP316079.203	1	1	0	0	1		
12	HCIP316147.109	0	0	0	0	0	2.87	0.52
13	HCIP316173.107	0	1	0	0	0		
14	HCIP316079.206	1	1	0	0	1		
15	HCIP316069.204	1	0	0	0	1		
16	HCIP316078.106	0	1	0	0	0		
17	HCIP316063.201	0	0	0	0	0		
18	HCIP316170.103	1	0	0	0	1		
19	HCIP316140.207	1	1	0	0	0		
20	HCIP316056.103	0	1	0	0	1	5.45	1.25
21	HCIP316121.108	1	1	0	0	1		
22	HCIP316163.107	1	0	0	0	1		
23	HCIP316078.102	0	0	0	0	0		
24	CIP 314957.16	0	1	0	0	1		
25	CIP 314953.2	0	1	0	0	1		

DNA analysis: 1= resistance present, 0= resistance absent

ANNEX 14: PERFORMANCE OF SELECTED CLONES FROM NON-REPLICATED TRIAL EVALUATED AT FARMERS' FIELDS IN DALAT FROM MARCH TO JUNE 2018

Sr No.	Clone	Marketable tubers/plant	Average marketable tuber weight (g)	Marketable tuber yield (t/ha)	Total tubers/ plant	Average total tuber weight (g)	Total tuber yield (t/ha)	DM (%)	Reducing sugar content (%)
1	CIP314950.8	3.40	88.8	15.0	9.2	50.4	23.0	17.5	0.25
2	CIP314953.2	2.70	90.8	12.3	4.9	70.2	16.8	22.2	0.25
3	CIP314965.39	2.38	152.4	17.5	3.6	106.6	18.7	19.2	0.27
4	HCIP316079.203	2.00	130.0	13.0	3.4	102.9	17.5	18.4	0.29
5	HCIP316045.103	1.20	133.3	8.0	5.8	51.7	15.0	16.1	0.32

ANNEX 15: YIELD OF THE SELECTED CLONES PLANTED IN POTS IN SCREENHOUSE IN DALAT FROM MARCH TO JUNE 2018

Sr No.	Clone	Yield/ plant (kg)	Average tuber wt (g)	Tubers/ plant
1	HCIP316177.10	0.300	42.9	7.0
2	HCIP316177.5	0.367	30.6	12.0
3	HCIP316177.4	0.486	38.6	12.6
4	HCIP316177.13	0.350	29.2	12.0
5	HCIP316177.9	0.350	28.0	12.5
6	HCIP316177.1	0.400	33.3	12.0
7	HCIP316073.3	0.533	31.4	17.0
8	HCIP316074.1	0.533	53.3	10.0
9	HCIP316170.1	0.340	32.1	10.6
10	HCIP316170.6	0.450	27.3	16.5
11	HCIP316170.2	0.650	35.1	18.5
12	HCIP316055.4	0.900	36.0	25.0
13	HCIP316055.2	0.350	26.9	13.0
14	HCIP316040.5	0.400	34.0	11.8
15	HCIP316040.4	0.600	34.3	17.5
16	HCIP316040.2	0.425	37.0	11.5
17	HCIP316040.7	0.525	54.5	9.6
18	HCIP316040.6	0.275	34.4	8.0
19	HCIP316175.1	0.471	36.3	13.0
20	HCIP316175.3	0.400	26.0	15.4
21	HCIP316170.3	0.500	62.5	8.0
22	HCIP316170.5	0.473	28.9	16.4
23	HCIP316014.2	0.550	62.9	8.8
24	HCIP316014.1	0.500	38.5	13.0
25	HCIP316020.1	0.600	43.9	13.7
26	HCIP316079.2	0.420	42.0	10.0
27	HCIP316079.3	0.700	48.3	14.5
28	HCIP316069.1	0.417	46.3	9.0
29	HCIP316039.6	0.450	30.7	14.7
30	HCIP316039.1	0.550	27.0	20.3
31	HCIP316049.3	0.500	35.7	14.0
32	HCIP316041.1	0.600	55.8	10.8
33	HCIP316041.3	0.400	28.6	14.0
34	HCIP316147.4	0.550	53.7	10.3
35	HCIP316147.1	0.560	20.6	27.2
36	HCIP316147.2	0.633	37.3	17.0
37	HCIP316147.3	0.517	29.8	17.3
38	HCIP316172.4	0.500	48.4	10.3
39	HCIP316136.1	0.583	35.7	16.3

Sr No.	Clone	Yield/ plant (kg)	Average tuber wt (g)	Tubers/ plant
40	HCIP316136.3	0.500	49.0	10.2
41	HCIP316007.1	0.300	40.0	7.5
42	HCIP316173.3	0.350	34.8	10.1
43	HCIP316173.2	0.445	24.3	18.4
44	HCIP316103.2	0.475	31.1	15.3
45	HCIP316163.4	0.450	31.0	14.5
46	HCIP316064.3	0.500	33.3	15.0
47	HCIP316064.1	0.600	69.2	8.7
48	HCIP316121.1	0.425	30.9	13.8
49	HCIP316121.3	0.560	40.6	13.8
50	HCIP316063.2	0.400	50.0	8.0
51	HCIP316063.4	0.560	37.8	14.8
52	HCIP316063.3	0.533	47.1	11.3
53	HCIP316063.5	0.767	46.9	16.3
54	HCIP316063.1	0.389	32.1	12.1
55	HCIP316054.2	0.425	31.5	13.5
56	HCIP316140.5	0.533	45.7	11.7
57	HCIP316174.7	0.633	47.5	13.3
58	HCIP316174.4	0.400	75.0	5.3
59	HCIP316132.4	0.300	25.7	11.7
60	HCIP316132.7	0.483	48.3	10.0
61	HCIP316132.2	0.400	49.3	8.1
62	HCIP316132.5	0.600	40.0	15.0
63	HCIP316132.11	0.417	35.7	11.7
64	HCIP316140.9	0.450	79.4	5.7
65	HCIP316140.8	0.300	47.4	6.3
66	HCIP316140.4	0.600	70.6	8.5
67	HCIP316148.1	0.367	55.0	6.7
68	HCIP316009.5	0.425	50.0	8.5
69	HCIP316009.2	0.567	65.4	8.7
70	HCIP316169.6	0.467	53.8	8.7

ANNEX 16: YIELD AND RELATED TRAITS OF THREE OF THE CIP SELECTED CLONES EVALUATED IN FIELD CONDITIONS (27M^2) AT DALAT FROM JUNE TO SEPTEMBER 2018

Sr No	Clone	No. of marketable tubers/plant	Average of marketable tuber weight (g)	Marketable tuber yield (t/ha)	Average of tuber weight (g)	Total number of tubers/plant	Total tuber yield (t/ha)
1	CIP310139.102	1.76	182.4	16.1	132.5	2.82	18.7
2	CIP310139.147	1.89	139.3	12.1	71.4	6.21	22.3
3	LB44-1-4-5	3.17	138.7	22.0	104.4	6.49	33.0
4	O7	1.79	157.6	14.1	94.3	4.35	20.2
5	PO3	1.80	144.3	12.2	79.0	5.52	21.5
6	Atlantic	0.91	120.8	5.53	87.2	2.06	8.98
	SD	**NS**	**NS**	**4.96**	**20.1**	**1.74**	**7.42**
	Variance			**24.6**	**403.8**	**3.04**	**55.1**
	SE			**2.28**	**8.93**	**0.547**	**2.14**
	CD			**7.19**	**28.1**	**1.72**	**6.85**
	CV (%)			**28.9**	**16.3**	**20.7**	**17.9**

ANNEX 17: PROCESSING TRAITS OF THREE OF THE CIP SELECTED CLONES EVALUATED IN FIELD CONDITIONS (27 M^2) AT DALAT FROM JUNE TO SEPTEMBER 2018

Sr No	Clone	DM (%)	Reducing sugar (%)	Chips Color (1=best,5=poorest)	French Fry Score (1=best,5=poorest)	Boiling (1= poorest, 9=best)
1	CIP310139.102	22.8	-	1.86	2.43	7.29
2	CIP310139.147	19.1	0.30	2.57	3.00	6.86
3	LB44-1-4-5	18.0	0.29	2.57	2.71	6.57
4	O7	18.5	0.28	2.71	2.43	6.86
5	PO3	21.1	0.28	2.00	2.00	7.00
6	Atlantic	22.0	0.30	1.00	1.00	7.43

ANNEX 18: YIELD TRAITS OF SIX OF THE CIP SELECTED CLONES EVALUATED IN FIELD CONDITIONS (3 M^2) AT DALAT FROM JUNE TO SEPTEMBER 2018

Sr No	Genotype	Number of marketable tubers/plant	Average of marketable tuber weight (g)	Marketable tuber yield (t/ha)	Average of tuber weight (g)	Total no. of tubers/ plant	Total tuber yield (t/ha)
1	CIP314957.6	2.23	170.6	16.7	121.5	4.22	20.7
2	CIP314960.13	3.72	160.0	23.7	109.7	6.37	30.0
3	CIP314960.50	1.11	193.6	7.5	127.2	3.58	14.2
4	CIP314968.73	3.33	137.3	23.0	107.7	5.93	32.0
5	CIP314969.79	2.47	177.1	21.3	126.8	4.33	27.5
6	CIP314970.13	2.00	168.5	16.3	91.1	6.13	28.0
7	Atlantic	2.53	192.9	20.7	131.7	4.49	26.0
8	O7	1.80	168.2	15.0	108.6	5.07	27.3
9	PO3	2.87	144.0	20.3	95.6	6.20	29.7
	SD	**0.655**	**NS**	**4.22**	**NS**	**0.838**	**4.47**
	Variance	**0.429**		**17.8**		**0.703**	**20.0**
	SE	**0.467**		**2.84**		**0.610**	**3.26**
	CD	**1.40**		**8.52**		**1.83**	**9.78**
	CV (%)	**33.0**		**27.0**		**20.5**	**21.6**

ANNEX 19: FLOWCHART OF VARIETY RELEASE PROCESS IN VIETNAM

	Phase 1
Step 1	Internal trial in 3 crop seasons, 27 m^2 area (9 m^2 x 3 replications) for each clone plus local checks.
Step2	Two demo plots for minimum of 1,000 m^2 each (up to 2,000 m^2). If seed is sufficient, this step can be done in parallel to Step 1. Local checks need to be involved.
Step3	Comprehensive report of 3 crop season trials and 2 demo trials with need to present with application to "Institutional Scientific Committee" of the institutes like FCRI and IAS according to zone. If agreed, the institute will submit the report proposal (not recommendations) to the DCP, which is the face of MARD. DCP will formulate a committee for evaluation of the report. If the committee agrees, it will proceed to deputy minister, who will agree to accept the proposal. DCP/MARD will then issue approval letter for official testing
	Phase 2
Step 4	Official testing of the clone at a scale of 50 ha in farmers' fields. Prepare a report on the testing results. Two province departments, "Province Agricultural" and "Rural Development," should be involved in the testing like Hai Duong, and Lam Dong. This trial can run parallel in both provinces. The report will be prepared by the breeder plus recommendations from the 2 provinces' departments.
Step 5	Submit the report (with results/report from Phase 1 also) along with the recommendations from provinces to the leadership of the institute like IAS and FCRI. The institute will formulate a scientific committee (same step like first basic testing). If accepted, the committee will recommend to the leader of the institute for proposing to ministry/DCP.
Step 6	DCP will formulate a scientific committee for evaluation (mostly breeders). They will rate and provide suggestions for improving the report.
Step 7	The improved report will be submitted to DCP that will go subsequently to the deputy minister. If he agrees to the report, DCP will issue official approval of variety releasing.

ANNEX 20: UPDATED GANTT CHART

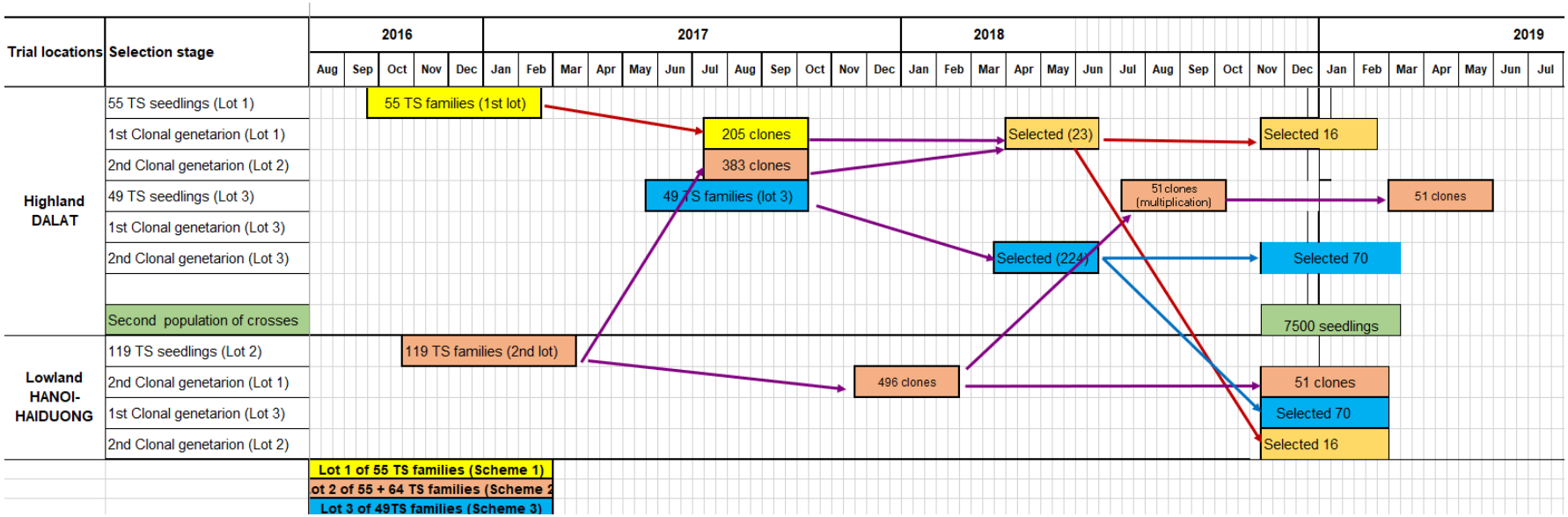

Figure 1. Crossing program in Huancayo, Peru for Lot 4.

Figure 2. Berries of the crosses.

Figure 3. TAP-5 team makes selections in Hai Duong.

Figure 4. Farmers' fields trial in Dalat, March–June 2018.

Figure 5. Selections in farmers' fields in Dalat.

Figure 6. Evaluation for chips and French fries of the selected clones.

Figure 7. Performance of HCIP316121.108 in the field and for chips and French fries.

Figure 8. Performance of HCIP316140.210 in the field and for chips and French fries.

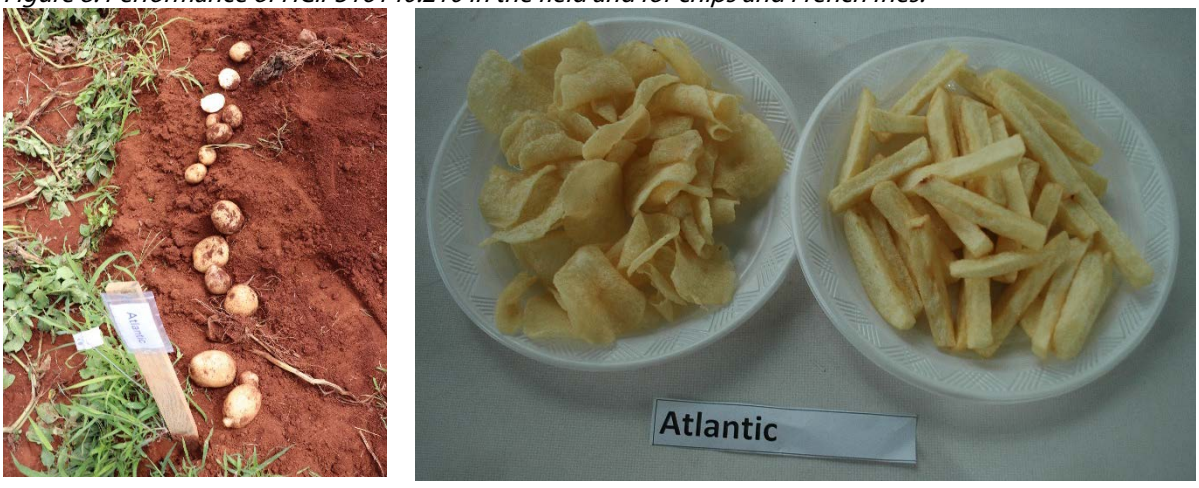

Figure 9. Performance of 'Atlantic' variety in the field and for chips and French fries.

Figure 10. Preparation of dried leaves samples to be sent to HZPC, Holland.

Figure 11. In vitro *multiplication of the selected clones for disease-free rapid multiplication.*

Figure 12. Screenhouse before and after installation of tables.

Figure 13. Weather station in Dalat.

Figure 14. Data logger in screenhouse.

Figure 15. Presentaion on TAP-5 project in CIP-MARD Workshop.

Figure 16. Dr. Doanh, vice minister MARD, addresses the CIP-MARD workshop.

Figure 17. Dr. Cuong (SFSA) addresses the participants in CIP-MARD workshop.

Figure 18. Dr. Barbara Wells, CIP's director general, visits TAP-5 trials and screenhouse in Dalat.

Figure 19. Dr. Tran Xuan Dinh and his team from DCP, MARD, visit the field experiments in Chuong My, Hanoi.

Figure 20. Dr. Cuong with TAP-5 team visiting field trials in Hai Duong.

Figure 21. Evaluation of clones in screenhouse.

Figure 22. Selections of the clones in screenhouse.

Figure 23. One of the selected clones in screenhouse.

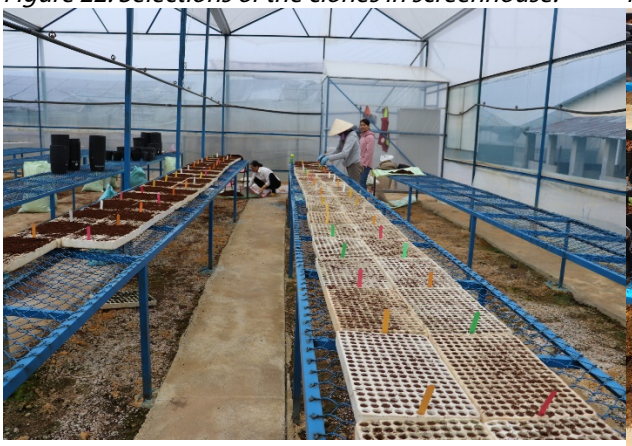

Figure 24. Sowing of TPS received under Lot 4.

Figure 25. Seedlings of Lot 4 in screenhouse.

Figure 26. Workshop on marketing session in Amsterdam.

Figure 27. Review and update meeting with Herve and Dr. Cuong in CIP-Hanoi office.

Figure 28. Midterm review meeting in Cusco, Peru.

Figure 29. Strategic meeting in Hanoi after the selections during February 2018.

Figure 30. Dr. Wells meets with Mr. Nhuan, director of PVFC.

Figure 31. Presentation to Graham Thiele, director of the CGIAR Research Program on Roots, Tubers and Bananas.

The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change, and the preservation of our Earth's fragile biodiversity and natural resources.

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