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

Progress Report

(September 2016–May 2017)

Prepared for:

Syngenta Foundation for Sustainable Agriculture

***Submitted by*:**

The International Potato Center (CIP)

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ACRONYMS

CIP	International Potato Center
FCRI	Field Crops Research Institute
HZPC	HZPC Holding B.V.
PPP	Private-public partnership
PVFC	Potato, Vegetable and Flower Research Center
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)

CIP Program Alignment: Through its Strategic Program 2, 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.

2. PROGRESS ON TAP-5 PROJECT THROUGH SEPTEMBER 2016

2.1 INSTITUTIONAL ARRANGEMENTS AND OPERATIONAL SETTING OF THE PROJECT

A private-public partnership (PPP) was established between CIP and HZPC and funded by SFSA in order to develop a collaborative breeding program focused on tropical potatoes. The project partners selected Vietnam as the most appropriate country in which to start operations. The expectation was that in the years to come this or related joint breeding efforts could be expanded to additional tropical and subtropical potato production environments.

The project aims to build on and combine the strengths of each partner in order to speed up and optimize the development of new potato varieties serving the needs of smallholder farmers in the context of productivity gains, quality assurance, diversification, climate change, and nutritional security.

The parties share the joint vision of food security and sustainable agriculture for potato farmers through improved varieties and farming technologies.

This report covers activities carried out in September 2016–May 2017, with some reference to past critical start-up information. In parallel to activities related to this PPP, each partner will continue to phenotype and characterize parents and progenies representing their respective genetics in their respective target environments (i.e., tropical environments for CIP and temperate environments for HZPC). New genetic materials will thus be available to the project when the partners wish to incorporate their new parental material.

2.1.1 Governance

A partnership committee was established, which comprises two members of each institution: Drs. Merideth Bonierbale and Oscar Ortiz (CIP) and Messrs. Robert Graveland and Richard Sanders (HZPC). Five Skype calls were held among the entire committee, after which spontaneous meetings have been held between fewer members, to address issues of timeliness.

2.1.2 People

A consultancy agreement was established with Dr. Dao Huy Chien, based in Vietnam, which will provide local expertise and breeding experience.

An international search has been conducted for a postdoctoral fellow who will conduct breeding operations. The needs of the day-to-day operation and relationship building with several stakeholders strongly recommended that the chosen person be fluent in Vietnamese and proficient in spoken and written English. Two candidates with good knowledge of potato breeding and management were identified, but neither speaks Vietnamese. The top candidate with excellent reference letters is an Indian national with a PhD in plant breeding and considerable experience in potato improvement and institutional relations at the international level. The post-doc breeder is expected to take up the post in Hanoi in August 2017.

After the post-doc potato breeder position was announced, CIP received two applications from Vietnamese nationals—one from an MSc plant breeder, Ms. Tuong Thi Ly, and the other from a PhD systems agronomist. Ms. Tuong has good command of English and works as head of research at the Potato, Vegetable and Flower Research Center (PVFC) in Dalat. She would likely be available for a consultancy to help implement the project, which makes use of her institute's facilities.

CIP and HZPC also contribute staff time from their respective headquarters and regional offices.

2.1.3 Genetics

- **Crossing blocks:** Owing to logistics affecting viability of pollen shipped from the Netherlands to Peru, the project's crossing block for combining CIP and HZPC selected progenitors had to be established a second time in 2016, to provide the first sufficient quantity of seed and genetic representation. Two lots of botanical seed one of 55 and the second of 119 hybrid families were dispatched to Vietnam in separate shipments to spread any risk of loss or complications with importation processes. Both lots were received by the Field Crops Research Institute (FCRI) on behalf of CIP.

  Update on genetic materials (2017): A third lot (Lot 3) of 49 true seed (TS) families from the same 2016 crossing block were prepared in Peru and shipped to Vietnam (PVFI, Dalat) on behalf of CIP in April 2017.The seed was sown in screenhouse in May 2017.

- **Genotyping of CIP and HZPC progenitors**: DNA of the progenitors was exchanged between CIP and HZPC. Molecular analysis is pending.

- **Establishment and clonal selection in Vietnam**: To take full advantage of diverse growing environments in Vietnam, the seed was divided into two lots (one lot having 55 families and the second 119 families). Two parallel selection schemes were designed, one starting in Dalat (mid-elevation tropical highlands) and the second beginning in the Red River Delta (RRD), Hanoi (subtropical lowlands).

  Update on clonal selection in Lots 1 and 2 (2017): In Dalat, germination rate was high, but persistent rains through 2016 led to the transplanting of Lot 1 of nearly 4,300 seedlings to the field in a very wet period. This affected the development of plants such that only approximately 30% of the population survived. The surviving plants showed depressed yield and tuber size, the number of tubers varied by 0–20 per seedling, and size was tiny to very small; however, 199 clones were selected based on uniformity of tuber size and shape. Because the majority of these clones need to be multiplied first to produce tubers that can be used for yield plots, we skipped the planned yield

trial in RRD during the coming cycle. The harvested tubers were stored in a simple diffused light store and will be planted again in Dalat in June 2017.

In Hanoi–Hai Duong (second scheme), nearly 12,160 seeds from 119 families were sown but only 18% of seeds germinated. The problem appears to have been poor management (e.g., inconsistent irrigation or improper soil cover during germination) as samples of the same seed germinated very well in Dalat. Seedlings were transplanted to beds, and 2,233 plants survived. Harvesting was carried out on 9 March and 496 clones were selected (343 selections from the first 55 families and 153 selections from the other 64). One set of the abovementioned materials has been stored in cold store for the next planting/evaluation in early November 2017, in the RRD. The other set has been stored in a simple diffused light store for bringing to Dalat for planting in the screenhouse at PVFC in July 2017. Annex 4 summarizes the number of selections by lot and by location.

- **A third lot of 49 TS families** (more than 8,700 seeds) remaining from the 2016 crossing block in Peru was dispatched from Peru to Vietnam and was sown in screenhouse in Dalat in May 2017.
- Construction of project facilities was postponed from Y1 to Y2 in order to more fully understand the best use of multiple environments to make genetic progress as fast as possible, and make investments useful for supporting national programs. Construction of a screenhouse has been planned for May 2016 to house the production of C1 tubers from seedlings of Lot 3 at PVFC in Dalat.

Deviation from proposed plan of work

Depending on overall and family performance, the partners had agreed that selection ratio may be about 50%, primarily based on selection against highly heritable negative features. Whereas around 50% of the population would be retained to preserve sufficient diversity to assess adaptation and specific traits targeted by the project. Selection ratios were lower than expected due to poor weather conditions in Dalat and poor management of seedlings in Hanoi which prevented full expression of genetic potential. This will be remedied by closer attention by experts during the May 2017 planting of remnant seed from 2016. The trade-off encountered by transplanting seedlings to the field is that we did not have screenhouse-grown seedling tubers for maintenance of a disease-free copy of each genotype for eventual introduction of top selections to in-vitro conditions. To offset this, one to two tubers of each C1 selection will be brought to Dalat, where healthy seed can be maintained in screenhouse conditions and propagated for use in subsequent selection cycles.

2.2 MAJOR ACCOMPLISHMENTS TO DATE

2.2.1 Major institutional commitments/agreements

CIP–HZPC and CIP–SFSA have each signed a major agreement for “collaboration on Breeding of Five Tropically Adapted Potato Varieties.”

A risk assessment was performed from June to August 2015, by SENASA in Peru to enable potato pollen from the Netherlands to be introduction into Peru.

2.2.2 Genetics

The first CIP–HZPC hybrid population was developed with female progenitors from CIP and male progenitors from HZPC. The direction of crosses followed the project’s strategy for germplasm exchange which called for the international transfer of pollen from the Netherlands to Peru. This required a risk assessment by Peruvian quarantine authorities and careful logistic arrangements by CIP and HZPC’s collaborating breeders and distribution units. It was successfully achieved on the second attempt at pollen transfer from HZPC’s facilities to CIP’s:

- 41 CIP progenitors and 9 HZPC progenitors were selected (Annex 1).
- Two sets of pollen of 9 HZPC progenitors were received by CIP in Peru.

In September 2015 and April 2016, crosses were carried out at CIP installations. More than 200 crosses resulted in more than 95,000 hybrid seeds comprising more than 200 bi-parental and inter-institutional combinations (Fig. 1).

Figure 1. Crosses.

Different seed sets were obtained for different crosses. CIP and HZPC breeders made a selection among these families that cut across the diversity obtained and were then adjusted according to experience of CIP with its progenitors. Seed was divided into two lots (Lot 1 and Lot 2) to spread any risk that might be encountered in shipment or establishment of the population in Vietnam.

Phytosanitary certificate and import permit were obtained for each lot comprising half of the seed of each of the 55 families (100–120 seeds each), totaling 6,500 seeds (Annex 2).

Hybrid seed from Lots 1 and 2 was dispatched from CIP in Peru to CIP in Vietnam through FCRI in June and September 2016, respectively.

Activities to be conducted during June–December 2017:

- Induct new hire at HZPC and possibly CIP in Peru finished by October 2017
- Organize and conduct a workshop on potato breeding and production in the tropics, with participation of Vietnamese national agricultural research representatives and project staff by the end of December 2017 (first week of December appears most feasible). Participation of researchers from additional Southeast Asian countries will be considered based on availability of funds.

Activities in Dalat:

A Gantt chart (timeline of activities) was modified based on the last results (Annex 3):

- Identify field facilities for multiplication of selected clones from Lot 1 (Dalat) by the end of April 2017.
- Plant the first clonal cycle in Dalat at field (2–10 tubers per clone) for tuber multiplication and plant 1–2 tubers per clone in pots in screenhouse for maintenance, by the end of June 2017.
- Plant selections from Lot 1 (Dalat) (Fig. 2).

Figure 2. Selected genotype from single hill (seedling) plot from Lot 1 —Dalat (Feb. 2017).

- Identify screenhouse facilities for multiplication and maintenance of selected clones from lot 1 (Dalat) and lot 2 (Hai Duong – Hanoi) (Fig. 3).
- Sow new set of 49 TS families (Lot 3) in May 2017, and transplant into pots in screenhouse in Dalat by June 2017.

Figure 3. Seedlings of Lot 1 of 55 TAP-5 families planted in Dalat on 13 September 2016.

Activities in RRD—Hai Duong:

- Tubers of selected genotypes from seedlings (C1) harvested and selected in March 2017, will be taken to Dalat for storage. One to two tubers for maintenance will be planted in pots in screenhouse by July 2017 and at field in RRD (2–10 tubers per clone) for multiplication, evaluation, and selection, by November 2017 (Annex 3).

2.2.3 Sites for planting potato experiments.

Potato experiments will be conducted in the following regions and sites, with specific arrangements to be made on a yearly basis:

- **RRD (5–10 masl)**:
  - Hanoi, Hai Duong, Thai Binh, Nam Dinh, Bac Ninh, Bac Giang.
- **Central highlands/Tropical highland:**
  - Dalat (1,500 masl) in Lam Dong province of the Central highlands, 1,495 km from Hanoi; Dalat is a tropical highland potato-growing region.
  - Duc Trong and Don Duong (900 masl) in Lam Dong province of the Central highlands, 1,465 km from Hanoi; Duc Trong and Don Duong are tropical highland potato production regions.
- **Northern highlands/Subtropical highlands:**
  - Sapa highland (1,581 masl): located in Lao Cai province in the northwest, about 375 km from Hanoi; Sapa is a subtropical highland potato-growing region and the site of the Potato Research Center of Vietnamese Academy of Agricultural Sciences.
  - Moc Chau highland (1,050 masl): Located in Son La province in the northwest, about 200 km from Hanoi; Moc Chau is a subtropical highland potato-growing environment.

2.2.4 Training

To improve the collection and quality of data, a small and preliminary training workshop on database management was carried out in Dalat (16 Feb. 2017) and Hanoi (21 Feb. 2017). Twelve technicians of PVFC in Dalat and 12 from FCRI of Hanoi participated. The High Interactive Data Analysis Platform developed by CIP was implemented. The main training topics were on data management, including generation of genotype lists, field books, statistical analysis, bar coding, and use of CIPCROSS software to manage crosses.

ANNEX 1. CIP AND HZPC PROGENITORS CONTRIBUTING TO TAP-5 HYBRID POPULATION

CIP parents

Ord	CIPNumber	Code	Variety Name	Pedigree		Tuber morphology				Resistance				
				Female	Male Parent	skin color	flsh color	shape	Depth eyes	PVY	PVX	PLRV	LB	Abiotic
1	CIP388615.22	C91.640		B-71-240.2	386614.16=(XY.16)	cr	cr	rnd	sh	ER	ER	S		H
2	CIP388676.1	Y84.027	M. BONITA	378015.18	PVY-BK	cr	wh	rnd	sh	ER			MR	H
3	CIP390478.9	C90.170	TACNA	720087=(SERRANA)	386287.1=(XY.4)	cr	cr	rnd	sh	ER	ER			H
4	CIP390637.1	93.003		PW-31	385305.1=(XY.9)	cr	cr	rnd	sh	ER	ER	S	S	
5	CIP390663.8	C91.628		SERRANA	XY.14	cr	wh	rnd	sh	R	ER	R	S	H
6	CIP391207.2	LR-93.050		800959=(GRANOLA)	385305.1=(XY.9)	cr	wh	rnd	sh	ER	ER	HR		
7	CIP391724.1	92.085		800959=(GRANOLA)	386316.1=(XY.20)	cr	cr	ob	sh	S	ER	MR		
8	CIP392025.7	LR-93.221		LINEA 21	386614.16=(XY.16)	cr	yll	lob	sh	ER	ER	S	MR	
9	CIP392739.4	92.062		86.001	386614.16=(XY.16)	cr	wh	rnd	sh	ER	ER	MR		
10	CIP392740.4	92.065		87.055	386614.16=(XY.16)	cr	cr	lob	sh	ER	ER	-		
11	CIP392820.1	C93.154		MONALISA	YY-5	cr	cr	ob	sh	ER	ER	R		
12	CIP392822.3	LR-93.073		MARIELA	YY.1	cr	cr	ob	sh	ER	S	R		
13	CIP392824.1	LR 93-271		800959=(GRANOLA)	386614.16=(XY.16)	cr	wh	ob	sh					
14	CIP395186.6	C95.406		C91.902	C92.032	cr	cr	ob	sh					
15	CIP395192.1	C95.381		C91.612	C92.044	cr	cr	rnd	sh	ER	ER	R		H
16	CIP395193.6	C95.416		388611.22=(C91.612)	C92.030	cr	cr	ob	sh	ER	MR	S		
17	CIP395434.1	C97.270		C91.612	N93.067	cr	cr	ob	sh	ER	ER		MS	H
18	CIP396311.1	C95.276		391925.2	C92.030	rd	cr	lob	sh	ER	ER		S	H
19	CIP397006.18	102.18		92.119	88.052	cr	cr	rnd	sh	ER	ER	S	S	H,D
20	CIP397077.16	WA.077/320.16		392025.7=(LR93.221)	392820.1=(C93.154)	cr	cr	ob	sh	ER	ER	S	S	D
21	CIP397079.6	317.6		MARIA TAMBEÑA	C93.154	cr	cr	ob	sh	ER	S	R		H,D
22	CIP300054.29	LR00.010		389746.2	BOGNA	pk	cr	rnd	sh	ER	ER			
23	CIP304350.100	LD-33.100		CHIEFTAIN	CIP392820.1 = (C93.154)	pk	cr	rnd	sh	R			S	H,D
24	CIP304350.118	LD-33.118		CHIEFTAIN	CIP392820.1 = (C93.154)	rd	cr	rnd	sh	R			VS	H,D
25	CIP304350.95	LD-33.95		CHIEFTAIN	CIP392820.1 = (C93.154)	rd	cr	ob	sh	R			S	H,D
26	CIP304371.67	LD-57.67		MONALISA	CIP392745.7 = (92.187)	cr	cr	ob	sh	R			S	H,D
27	CIP304383.80	LD-69.80		rd PONTIAC	CIP392745.7 = (92.187)	cr	wh	ob	sh	R			VS	H,D
28	CIP304387.39	LD-73.39		REINHORT	CIP392745.7 = (92.187)	cr	cr	ob	sh	R			VS	H,D
29	CIP304399.15	LD-85.15		SNOWDEN	CIP392745.7 = (92.187)	cr	cr	rnd	md	R			S	H,D
30	CIP302476.108	LD-88.108		TITIA	CIP392745.7 = (92.187)	pk	yll	lob	sh	R			S	H,D
31	CIP304349.25	LD-32.25		CHIEFTAIN	CIP392745.7 = (92.187)	cr	wh	ob	sh	R			S	H,D
32	CIP398017.53			391002.6	392639.31	cr	cr	ob	sh	ER			R	H
33	CIP398098.119			393371.58	392639.31	cr	cr	ob	sh	S	ER		R	H
34	CIP3398203.244			393280.82	392633.64	rd	cr	ob	sh	S	ER		R	H
35	CIP398208.29			393371.58	392633.64	cr	cr	ob	sh	ER	ER		R	H
36	CIP398208.620			393371.58	392633.64	cr	cr	ob	sh				R	H
37	CIP398208.670			393371.58	392633.64	cr	cr	ob	sh				R	H
38	CIP398208.704			393371.58	392633.64	pk	cr	ob	sh		ER		R	H
39	CIP398192.553			393077.54	392633.54	pk	cr	ob	sh				R	H
40	CIP398201.510			393242.5	392633.64	pk	cr	ob	sh				R	H
41	CIP398208.33			393371.58	392633.64	pk	cr	ob	sh				R	H

R=Resistance, ER=Extreme Resistance, MR=Moderate Resistancre, S=Susceptible, VS=Very Susceptible

cr=cream, pk=pink, rd=red, wh=white, yll=yellow, rnd=round, ob=oblong, lob=long oblong, sh=shallow

HZPC Progenitors

HZPC parents

Tube code	Progenitor	amount of pollen	type G=Granola, A=Atlantic	resistances nematodes / blight	RELATIVE YIELD	MATURITY 40-90	DORMANCY PERIOD 10-90	TUBER SIZE 90 = 70 mm+	SHAPE	FLESH COLOUR	SKIN COLOUR	OVERALL IMPRESSION	DM%	COOKING TYPE	SECOND FRY 10-90	CRISPS 10-90	LATE BLIGHT FOLIAGE 10-90
HCIP 53	FARIDA	moderate	Spunta / G		127	63	59	84	OLO	LY	Y	66	19.0	bit mealy	49		55
HCIP 79	HOM 12-7449	OK	A	G. rost.1 , S.dms R-genes	64	68	52	50	OLO	CR	LY	54	24.2	mealy	75	55	99
HCIP 90	HOT 09-8123	OK	A/G	G.pallida	103	61	59	77	OLO	LY	Y	64	21.3	firm-mealy	63	54	39
HCIP 146	HZD 06-1249	moderate	A	G. rost.1 + pallida	134	56	52	84	OLO	CR	Y	68	21.1	bit mealy	59		
HCIP 239	MONDIAL	OK	Spunta / G	G. rost.1	129	50	61	84	LO	LY	Y	68	19.9	bit mealy	60	50	50
HCIP 247	PANAMERA	scarce	Spunta / G		117	45	64	85	O	LY	Y	67	20.7	firm-mealy	54		65
HCIP 312	VDW 09-545	moderate	A	G. rost.1	151	63	64	87	O	Y	Y	63	20.6	bit mealy	71		
HICP 328	ZIJ 01-49	OK	G	G. rost.1	123	48	70	82	ROO	Y	Y	66	20.6	bit mealy	61		51
HCIP 7031	HOM 12-7145	moderate	G	G. rost.1 + blight !	112	70	51	80	RRO	LY	Y	69	19.5	firm-mealy	62	40	

LO = long oval, OLO = oval-long-oval, O = oval, ROO = oval - round-oval, RRO = rond - round-oval

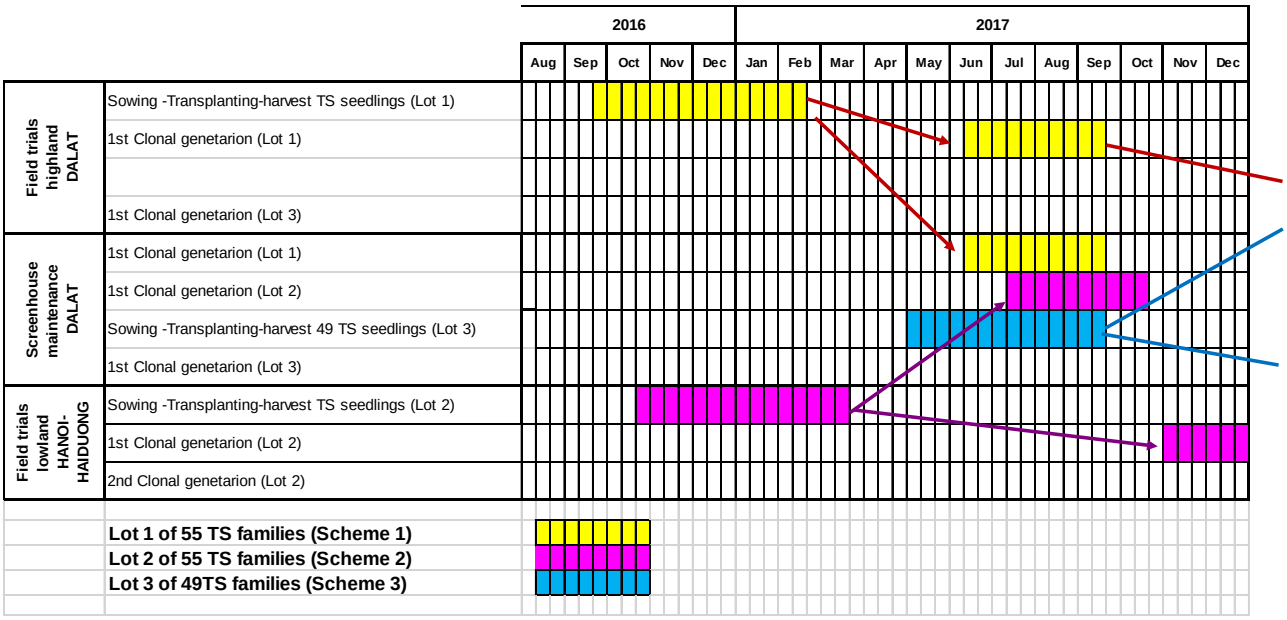
Y = yellow, LY = light-yellow, CR = crème

Annex 2. CIP–HZPC combinations resulting in true seed for TAP-5 project

	CIP Number	Female Parent (CIP parents)		Male Parent (HZPC parents)		1st PILOT	2nd PILOT
		CIP Number	Code	Code 1	Code 2		
1	**CIP316002**	CIP300054.29	LR00.010	HOM 12-7145	HCIP 7031	120	120
2	**CIP316007**	CIP302476.108	LD-88.108	HOM 12-7145	HCIP 7031	120	120
3	**CIP316008**	CIP302476.108	LD-88.108	HOM 12-7449	HCIP 79	120	120
4	**CIP316009**	CIP304349.25	LD-32.25	HOM 12-7145	HCIP 7031	120	120
5	**CIP316013**	CIP304350.100	LD-33.100	FARIDA	HCIP 53	100	100
6	**CIP316014**	CIP304350.100	LD-33.100	HOM 12-7145	HCIP 7031	120	120
7	**CIP316018**	CIP304350.118	LD-33.118	VDW 09-545	HCIP 312	100	100
8	**CIP316019**	CIP304350.118	LD-33.118	FARIDA	HCIP 53	100	100
9	**CIP316020**	CIP304350.118	LD-33.118	HOM 12-7145	HCIP 7031	120	120
10	**CIP316039**	CIP304387.39	LD-73.39	FARIDA	HCIP 53	120	120
11	**CIP316040**	CIP304387.39	LD-73.39	HOM 12-7145	HCIP 7031	120	120
12	**CIP316041**	CIP304387.39	LD-73.39	HOM 12-7449	HCIP 79	120	120
13	**CIP316049**	CIP388615.22	C91.640	HOM 12-7145	HCIP 7031	120	120
14	**CIP316050**	CIP388615.22	C91.640	HOM 12-7449	HCIP 79	120	120
15	**CIP316053**	CIP388676.1	Y84.027	MONDIAL	HCIP 239	120	120
16	**CIP316054**	CIP388676.1	Y84.027	VDW 09-545	HCIP 312	120	120
17	**CIP316055**	CIP388676.1	Y84.027	FARIDA	HCIP 53	120	120
18	**CIP316056**	CIP388676.1	Y84.027	HOM 12-7145	HCIP 7031	120	120
19	**CIP316057**	CIP388676.1	Y84.027	HOM 12-7449	HCIP 79	120	120
20	**CIP316062**	CIP390478.9	C90.170	FARIDA	HCIP 53	120	120
21	**CIP316063**	CIP390478.9	C90.170	HOM 12-7145	HCIP 7031	120	120
22	**CIP316064**	CIP390478.9	C90.170	HOM 12-7449	HCIP 79	120	120
23	**CIP316069**	CIP390637.1	93.003	HOM 12-7145	HCIP 7031	120	120
24	**CIP316073**	CIP390663.8	C91.628	FARIDA	HCIP 53	120	120
25	**CIP316074**	CIP390663.8	C91.628	HOM 12-7145	HCIP 7031	120	120
26	**CIP316075**	CIP390663.8	C91.628	HOM 12-7449	HCIP 79	120	120
27	**CIP316079**	CIP391207.2	LR-93.050	HOM 12-7145	HCIP 7031	120	120
28	**CIP316080**	CIP391207.2	LR-93.050	HOM 12-7449	HCIP 79	120	120
29	**CIP316083**	CIP391724.1	92.085	FARIDA	HCIP 53	120	120
30	**CIP316084**	CIP391724.1	92.085	HOM 12-7145	HCIP 7031	120	120

	CIP Number	Female Parent (CIP parents)		Male Parent (HZPC parents)		1st PILOT	2nd PILOT
		CIP Number	Code	Code 1	Code 2		
31	**CIP316085**	CIP391724.1	92.085	HOM 12-7449	HCIP 79	120	120
32	**CIP316094**	CIP392740.4	92.065	MONDIAL	HCIP 239	120	120
33	**CIP316095**	CIP392740.4	92.065	VDW 09-545	HCIP 312	120	120
34	**CIP316100**	CIP392820.1	C93.154	VDW 09-545	HCIP 312	120	120
35	**CIP316101**	CIP392820.1	C93.154	FARIDA	HCIP 53	120	120
36	**CIP316102**	CIP392820.1	C93.154	HOM 12-7145	HCIP 7031	120	120
37	**CIP316103**	CIP392820.1	C93.154	HOM 12-7449	HCIP 79	120	120
38	**CIP316121**	CIP395193.6	C95.416	HOM 12-7145	HCIP 7031	120	120
39	**CIP316125**	CIP396311.1	C95.276	FARIDA	HCIP 53	100	100
40	**CIP316126**	CIP396311.1	C95.276	HOM 12-7145	HCIP 7031	120	120
41	**CIP316127**	CIP396311.1	C95.276	HOM 12-7449	HCIP 79	120	120
42	**CIP316132**	CIP397006.18	102.18	HOM 12-7145	HCIP 7031	120	120
43	**CIP316136**	CIP397079.6	317.6	MONDIAL	HCIP 239	120	120
44	**CIP316140**	CIP397079.6	317.6	HOM 12-7145	HCIP 7031	120	120
45	**CIP316147**	CIP398017.53		HOM 12-7145	HCIP 7031	120	120
46	**CIP316148**	CIP398017.53		HOM 12-7449	HCIP 79	120	120
47	**CIP316153**	CIP398098.119		HOM 12-7449	HCIP 79	120	120
48	**CIP316163**	CIP398201.510		HOM 12-7145	HCIP 7031	120	120
49	**CIP316169**	CIP398208.29		FARIDA	HCIP 53	120	120
50	**CIP316170**	CIP398208.29		HOM 12-7145	HCIP 7031	120	120
51	**CIP316172**	CIP398208.33		MONDIAL	HCIP 239	120	120
52	**CIP316173**	CIP398208.33		VDW 09-545	HCIP 312	120	120
53	**CIP316174**	CIP398208.33		FARIDA	HCIP 53	120	120
54	**CIP316175**	CIP398208.33		HOM 12-7145	HCIP 7031	120	120
55	**CIP316177**	CIP398208.620		HOM 12-7145	HCIP 7031	120	120
						6,520	6,520

ANNEX 3. GANTT CHART OF ACTIVITIES (MODIFIED SCHEME)



ANNEX 4. NUMBER OF SEEDS AND SELECCTIONS

Ord	CIP Number TS Family	Number of Seeds Dispatched			Number of Survival Plants			Number of Selected Clones		
		1st Lot May 2016	2nd Lot June 2016	3rd Lot Apr. 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat June 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat Sept. 2017
1	CIP316002	120	120	200	14	19			8	
2	CIP316007	120	120	200	18			6		
3	CIP316008	120	120	96	11	13		2	2	
4	CIP316009	120	120	200	16	36		2	7	
5	CIP316013	100	100		14	4		3		
6	CIP316014	120	120	200	6	8				
7	CIP316018	100	100		12	10		1		
8	CIP316019	100	100		7	9				
9	CIP316020	120	120	200	22	46		6	4	
10	CIP316039	120	120	200	7	10				
11	CIP316040	120	120	200	12	27		2	4	
12	CIP316041	120	120	200	25	47			10	
13	CIP316049	120	120	200	26	42		5	4	
14	CIP316050	120	120	140	5	52			3	
15	CIP316053	120	120	200	22	51		4	15	
16	CIP316054	120	120	70	17	36		1	12	
17	CIP316055	120	120	200	27	45			12	
18	CIP316056	120	120	200	25	56		5	28	
19	CIP316057	120	120	140	43	12		13	4	
20	CIP316062	120	120	200	31	12		1		
21	CIP316063	120	120	200	67	20		6	8	
22	CIP316064	120	120	200	52	57		3	7	
23	CIP316069	120	120	200	28	51		3	10	
24	CIP316073	120	120	110	28	30			8	
25	CIP316074	120	120	200	25	23		3		
26	CIP316075	120	120	150	42	23		1		
27	CIP316079	120	120	200	21	31			6	
28	CIP316080	120	120	200	17	20			5	
29	CIP316083	120	120	200	28	15		2		
30	CIP316084	120	120	150	33	37		4	13	
31	CIP316085	120	120		23	58		4	25	
32	CIP316094	120	120	120	28	9		2	3	
33	CIP316095	120	120	120	42	66		2	18	
34	CIP316100	120	120	125	20	29		2	2	
35	CIP316101	120	120	200	8	4				
36	CIP316102	120	120	200	25	57		2	17	
37	CIP316103	120	120	200	25	17		3	1	

Ord	CIP Number TS Family	Number of Seeds Dispatched			Number of Survival Plants			Number of Selected Clones		
		1st Lot May 2016	2nd Lot June 2016	3rd Lot Apr. 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat June 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat Sept. 2017
38	CIP316121	120	120	200	81	45		21	5	
39	CIP316125	100	100		31	16		4	5	
40	CIP316126	120	120	200	27	35		4	3	
41	CIP316127	120	120		11	9		1		
42	CIP316132	120	120	200	20	16		6	7	
43	CIP316136	120	120	100	27	12		4	3	
44	CIP316140	120	120	200	11	61		1	20	
45	CIP316147	120	120	150	17	6		9	3	
46	CIP316148	120	120	200	30	58		7	21	
47	CIP316153	120	120	80	70	29		7		
48	CIP316163	120	120	200	17	36		9	9	
49	CIP316169	120	120	200	12	19			6	
50	CIP316170	120	120	200	12	32		14	7	
51	CIP316172	120	120	200	22	40		1	8	
52	CIP316173	120	120	200	22	7		8		
53	CIP316174	120	120	200	50	16		8	3	
54	CIP316175	120	120	200	51	28		7	7	
55	CIP316177	120	120	200	3	8				
56	CIP316003		70			16			3	
57	CIP316006		100							
58	CIP316015		80							
59	CIP316017		40			4				
60	CIP316021		40			21			5	
61	CIP316023		100							
62	CIP316026		50							
63	CIP316027		80			27			10	
64	CIP316028		120			6			3	
65	CIP316033		100							
66	CIP316034		40			48			16	
67	CIP316035		40							
68	CIP316038		40			24			4	
69	CIP316044		120							
70	CIP316045		120			32			12	
71	CIP316052		70							
72	CIP316060		50							
73	CIP316066		90			10				
74	CIP316067		50			13			5	
75	CIP316068		120			12			4	

Ord	CIP Number TS Family	Number of Seeds Dispatched			Number of Survival Plants			Number of Selected Clones		
		1st Lot May 2016	2nd Lot June 2016	3rd Lot Apr. 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat June 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat Sept. 2017
76	CIP316070		80			14			3	
77	CIP316078		120			27			13	
78	CIP316087		120							
79	CIP316088		120			15			4	
80	CIP316091		100							
81	CIP316092		120							
82	CIP316093		100			37			13	
83	CIP316097		120			108				
84	CIP316098		70							
85	CIP316099		50			20			11	
86	CIP316106		120							
87	CIP316107		80							
88	CIP316110		120			16			3	
89	CIP316111		120			19			4	
90	CIP316115		80							
91	CIP316116		80			30			3	
92	CIP316117		120			18			4	
93	CIP316118		120			33			4	
94	CIP316120		120			24			9	
95	CIP316122		120			6				
96	CIP316123		80							
97	CIP316124		40			10				
98	CIP316130		40							
99	CIP316131		80							
100	CIP316133		80			5				
101	CIP316135		120							
102	CIP316138		70							
103	CIP316141		80							
104	CIP316142		60			15				
105	CIP316144		120			22			8	
106	CIP316145		40							
107	CIP316146		40							
108	CIP316151		120							
109	CIP316154		80							
110	CIP316155		100			7			3	
111	CIP316156		120							
112	CIP316157		120							
113	CIP316158		100							

Ord	CIP Number TS Family	Number of Seeds Dispatched			Number of Survival Plants			Number of Selected Clones		
		1st Lot May 2016	2nd Lot June 2016	3rd Lot Apr. 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat June 2017	1st Lot Dalat	2nd Lot Hai Duong	3rd Lot Dalat Sept. 2017
114	CIP316159		50							
115	CIP316164		120							
116	CIP316165		40							
117	CIP316166		120			21			6	
118	CIP316171		100							
119	CIP316178		120			18			3	
		6520	12160	8751	1386	2233		**199**	**496**	