Progress Breeding CIP HQ Hybrid Breeding & SPVD markers

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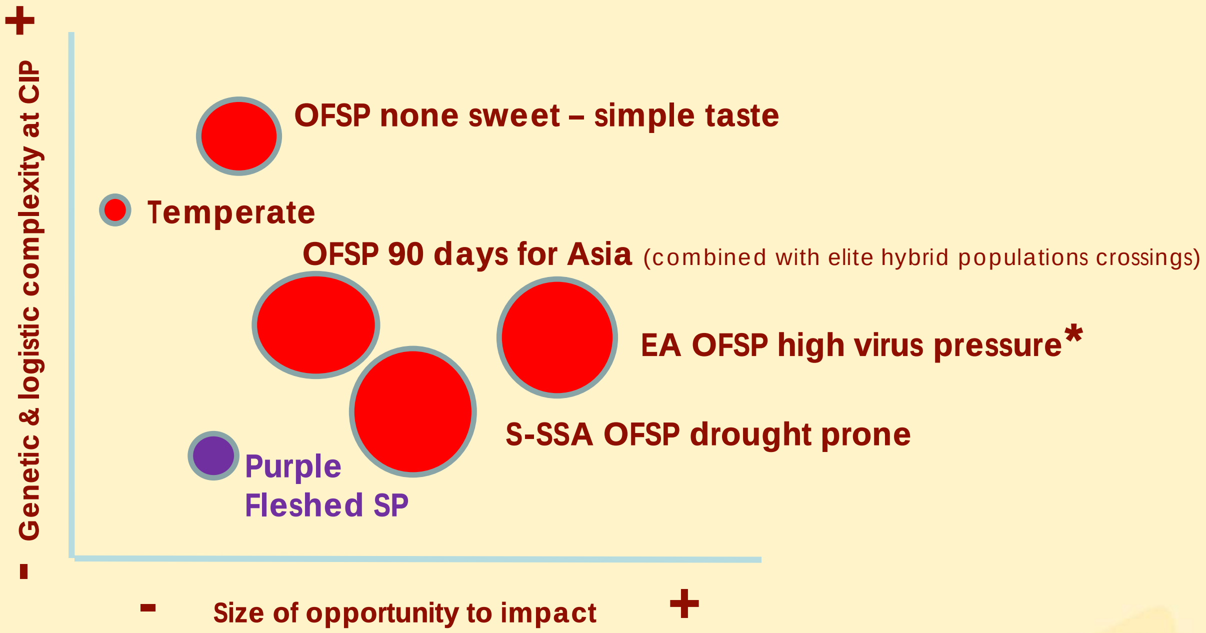
Building Resilient Food Systems with Sweetpotato

17th Sweetpotato SpeedBreeders and Genomics Community of Practice Meeting, Nairobi, Kenya

05-08 June 2018

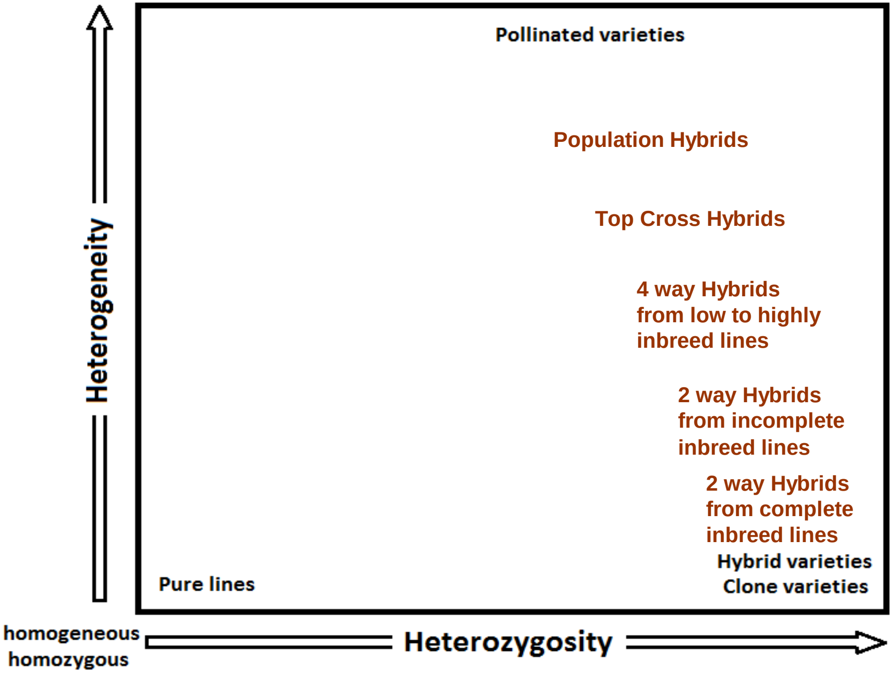
SWEETPOTATO ACTION FOR SECURITY AND HEALTH IN AFRICA

CIP product concepts – relative global effort



*: Size of each circle reflects current breeding efforts

Methods and categories of plant breeding



Schnell F.W. 1982: A synoptic study of the methods and categories of plant breeding. Plant Breeding 89:1-18.

At CIP-HQ 2004 - 2008

Formation of 2 OFSP populations: “Jewel” (PJ) and “Zapallo (PZ)”

The PJ generated end of 1990s at CIP in Peru / open pollination among 98 clones using “desert type” OFSP and sweetpotato germplasm from different regions.

The PZ generated in a factorial cross design (13 male x 120 female parents). Male parents from South America or Africa with light to medium orange or cream fleshed storage root color

PJ 2005, selection, recombination, multiplication to PJ 2007 in field trials 2007 (PJ05, PJ07)

PZ 2006, selection, recombination, multiplication to PZ 2008 in field trials 2008 (PZ06, PZ08)

Published two studies on heterosis increments without genepool separation:

- 2007/2008 at CIP in Peru / Grüneberg et al. (2015) mid-parent and mid-offspring yield 48 families (4 x 12 factorial cross) **heterosis yield increments -34% to 58%.**
- 2010/11 at KARI in Kenya / Kivuva et al. (2015) F1 and parental means (6 parents, 15 families); mid-parent – mid-offspring **heterosis yield increments under no drought -43% to 92%** and **-54% to 82% under drought stress**

Published - Genepool separation with Heterosis and Hybrid breeding in sweetpotato

- 20010/2011 at CIP in Uganda / David al. (2018) Gene Pool Subdivision of East African Sweetpotato Parental Material. Crop Science in press
- mid-parent and mid-offspring yield 48 families (4 x 12 factorial cross) **heterosis yield increments -34% to 58%**

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At CIP we improve populations through:

(i) Polycrosses with parental selection on clone performance *per se*

(ii) Reciprocal Recurrent Selection & Offspring Parent analysis

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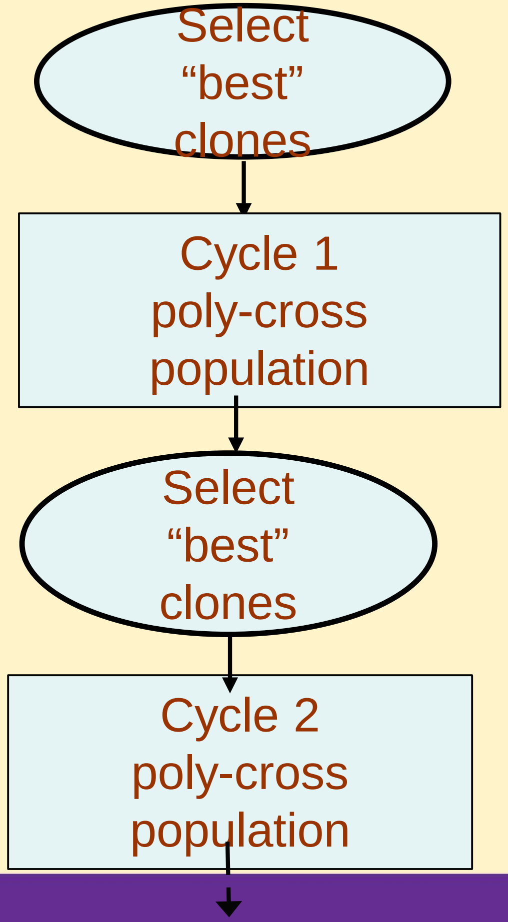
Poly-cross breeding



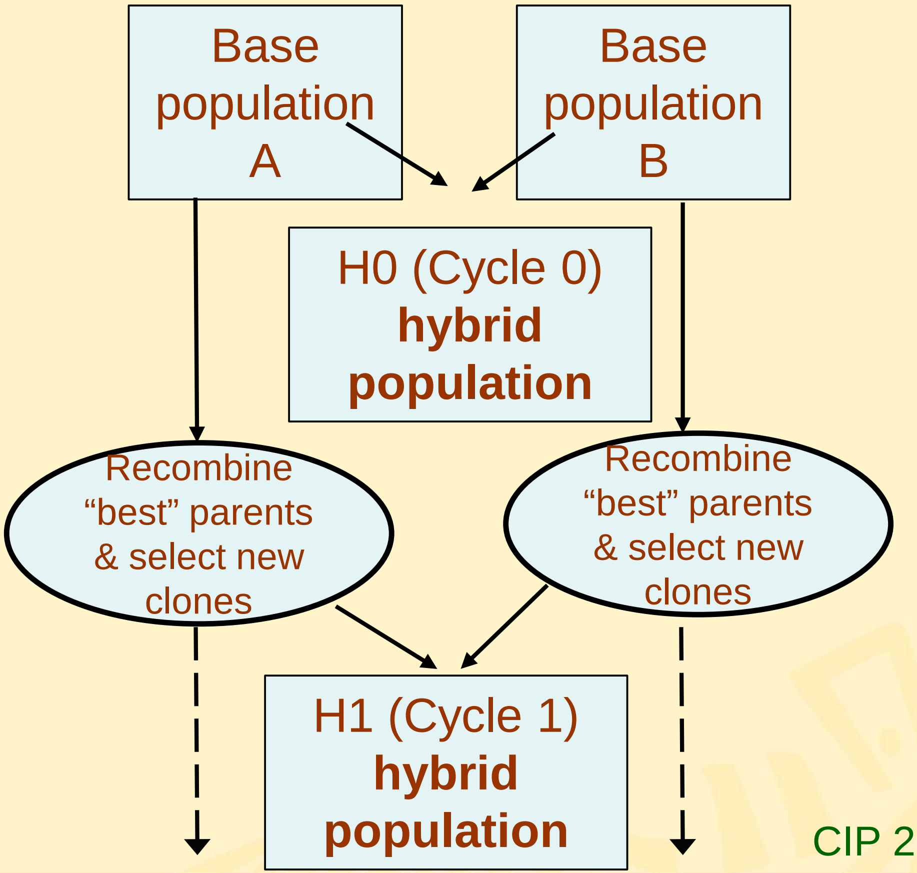
Select “best” clones

Cycle 1 poly-cross population

Select “best” clones

Cycle 2 poly-cross population

Reciprocal recurrent selection



Base population A

Base population B

H0 (Cycle 0) **hybrid population**

Recombine “best” parents & select new clones

Recombine “best” parents & select new clones

H1 (Cycle 1) **hybrid population**

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PJ and PZ population at CIP-HQ relative to Mega-Clones

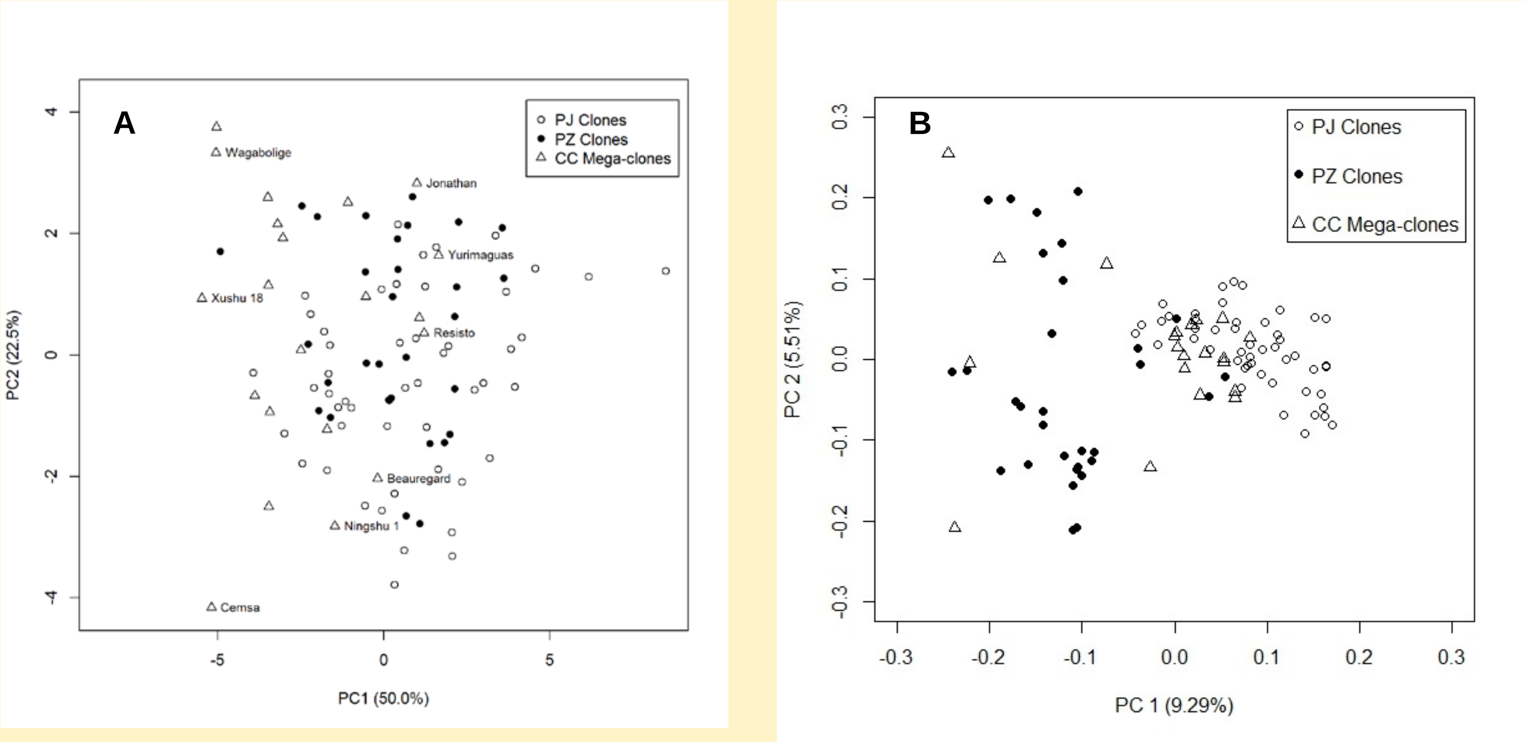

Fig. 1. Frist (PC1) and second (PC2) principal component scores of the principal component analyses of 49 PJ 31 PZ, and 21 mega clones on agronomic yield and quality trails (A). ist (PC1) and second (PC2) principal component scores of the principal component analyses of 49 PJ 31 PZ, and 21 mega clones on agronomic yield and quality trails (A); Frist (PC1) and second (PC2) principal component scores of the principal component analyses of 49 PJ 31 PZ, and 21 mega clones on 66 SSR marker data (B).

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CIP 2009-2013 / SASHA phase 1 – H0 population PH10 PJ and PZ populations are mutually heterotic

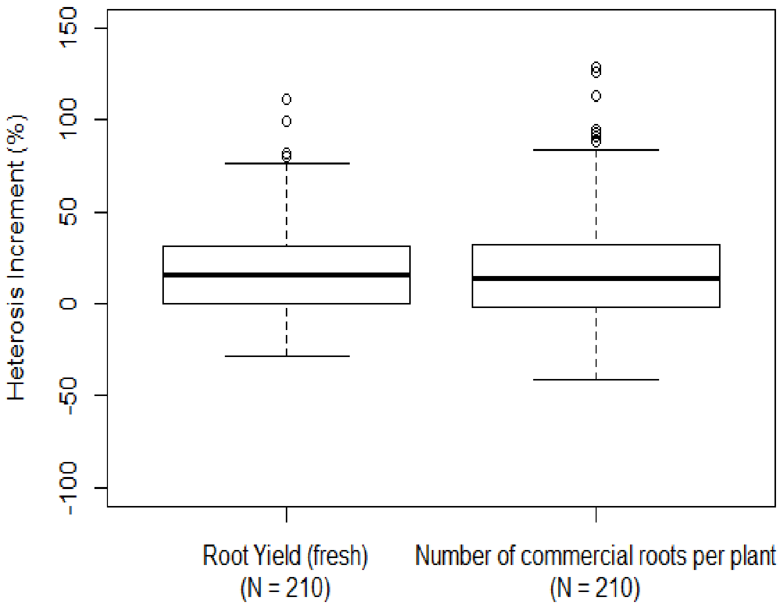

Fig 2. Heterosis increments in percentage for yield and number of commercial roots per plant in H0 PJxPZ cross combinations (N=210) across experimental sites [zero is parental basis (PJ parent + PZ parent) / 2, PJ parents (N=49), and PZ parents (N=31) across experimental sites (Huaral, San Ramon) and replications (n=2)

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Another H0 population on basis of PJ05, PJ07 and PZ06, PZ08 parents funded by USAID for 100 days OFSP H0 hybrid population PH15)

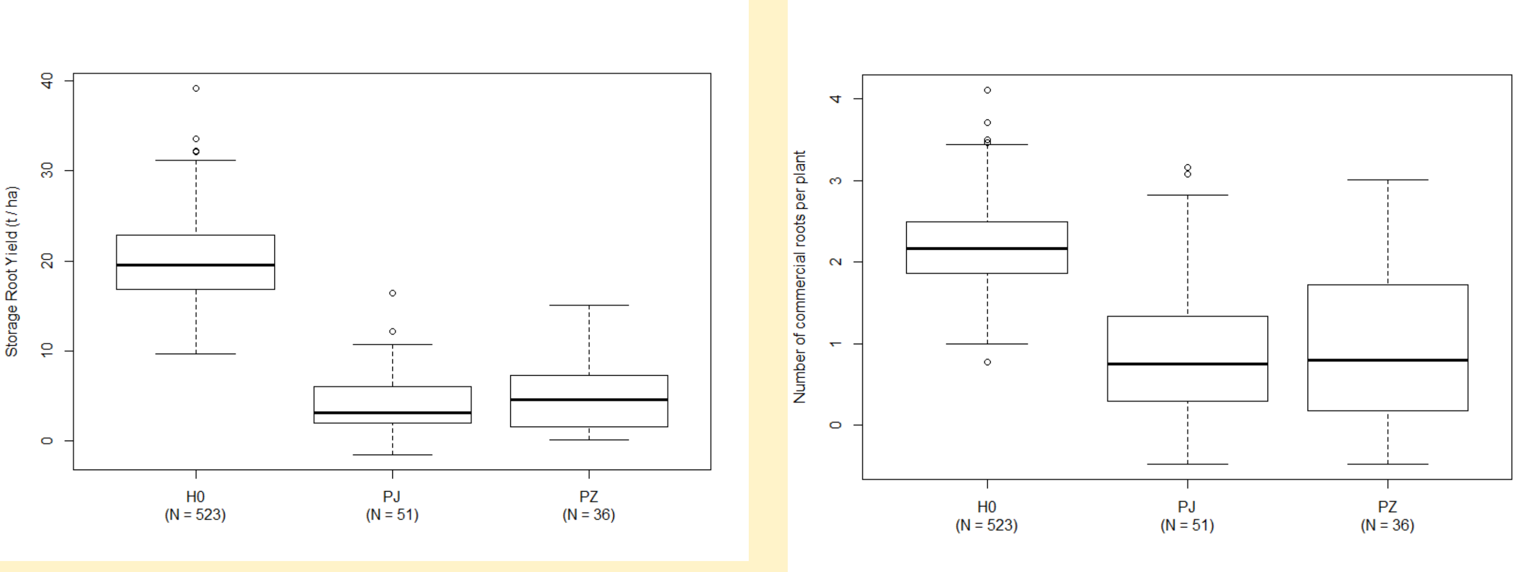

Fig. 3. Storage root yields (A) and number of commercial storage roots per plant (B) for H0 cross combinations (N=523 cross combinations) with PJ and PZ parents across experimental sites (Ica, Satipo).

Note: This hybrid population was "stressed" due to 100 days harvest / many parents were already PJ07 and PZ08 parents.

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Uganda Parents Inter AxB - Intra pool crosses (AxA & BxB)

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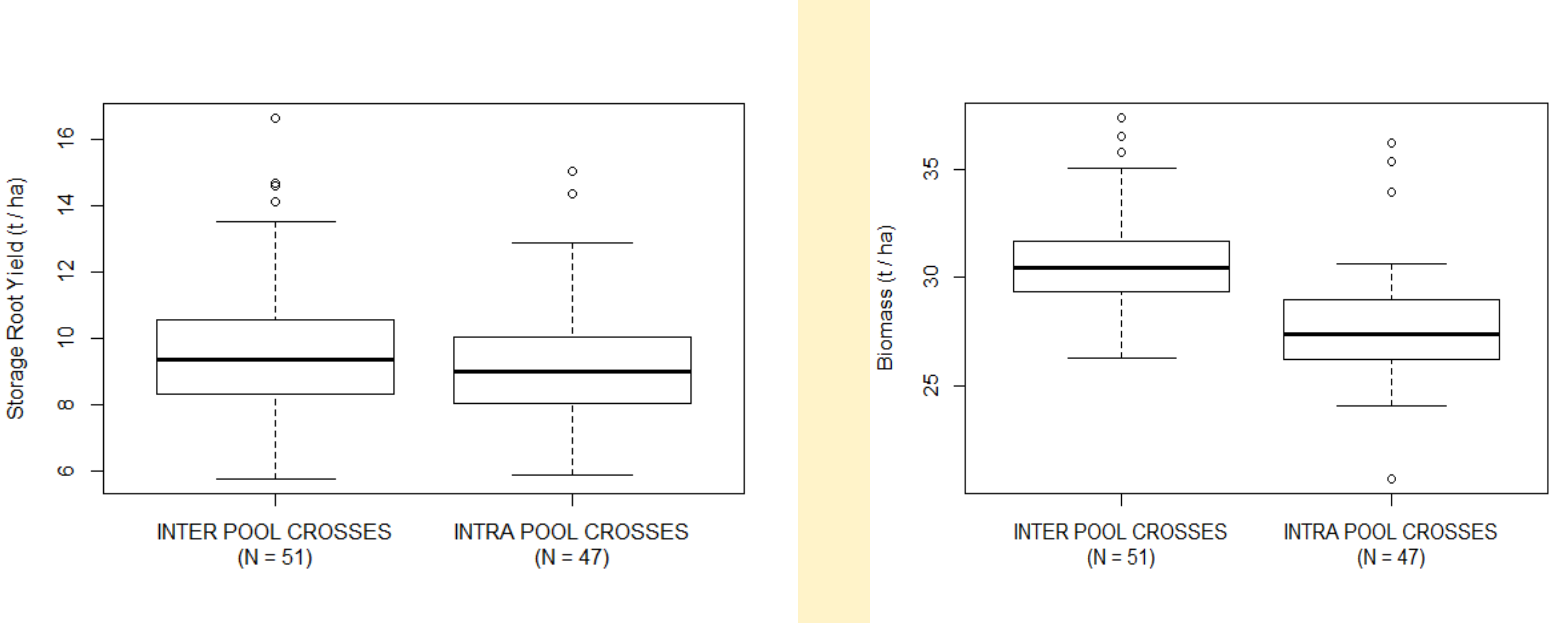

Fig. 4 Storage root yields (A) and total biomass production (B) for interpool (AxB) and intrapool (AxA and BxB) crosses across environments (irrigated in 2015 and 2016, not irrigated in 2015 and 2016).

The hybrid breeding scheme for three big experiments 1) High iron, 2) None sweet, 3) wide adaptation and earliness

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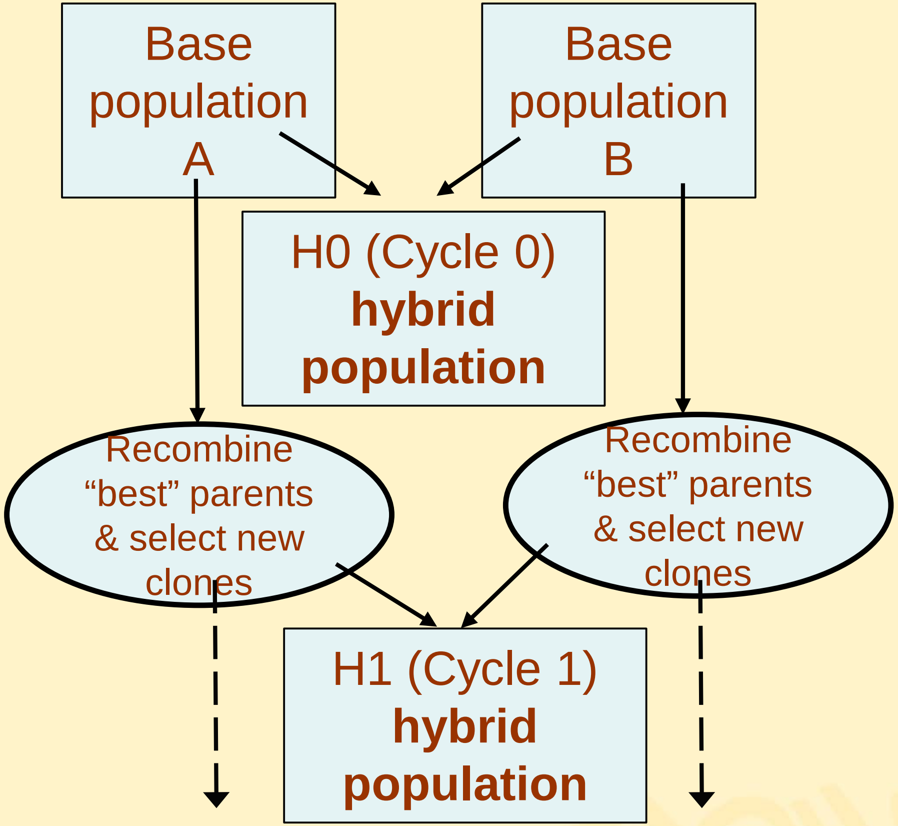
Reciprocal recurrent selection



Base population A

Base population B

H0 (Cycle 0) **hybrid population**

Recombine “best” parents & select new clones

Recombine “best” parents & select new clones

H1 (Cycle 1) **hybrid population**

CIP 2018

CIP 2014-2019 / SASHA phase 2
Genetic Grains & Heterosis increments in high iron hybrid H1 population

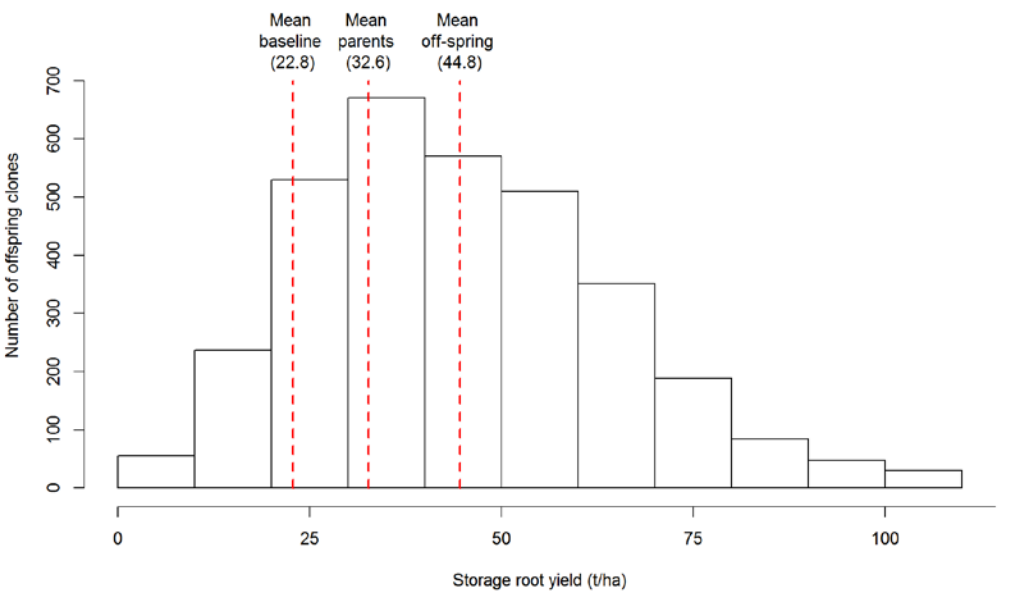


Fig. 5. Genetic gain (GG) for storage root yield by genepool separation and one complete reciprocal recurrent selection cycle estimated in population HIFE at two locations in Peru / Canete – arid pacific coast / Satipo – humid tropics [Mean baseline (22.8 t/ha), 80 clones each clone in 8 one-meter row plot replications, selected fraction in baseline PJ = 0.10 and PZ = 0.16; mean parents (32.6 t/ha), 46 clones each clone in 8 one-meter row plot replications; mean offsprings (44.8 t/ha), 3292 H1 hybrid clones; total GG: 96.2%; heterosis increment in H1: 36.4%, estimated gain by one reciprocal recurrent selection cycle: 43.8%].

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Iron and zinc H1 population (about 4000 genotypes / 2 locations with checks and with parents are evaluated by NIRS – about 15 USD per sample plus selected fraction by XRF (14 USD per sample)

CIP 2014-2019 / SASHA phase 2 Genetic Grains & Heterosis increments in none sweet hybrid H1 population

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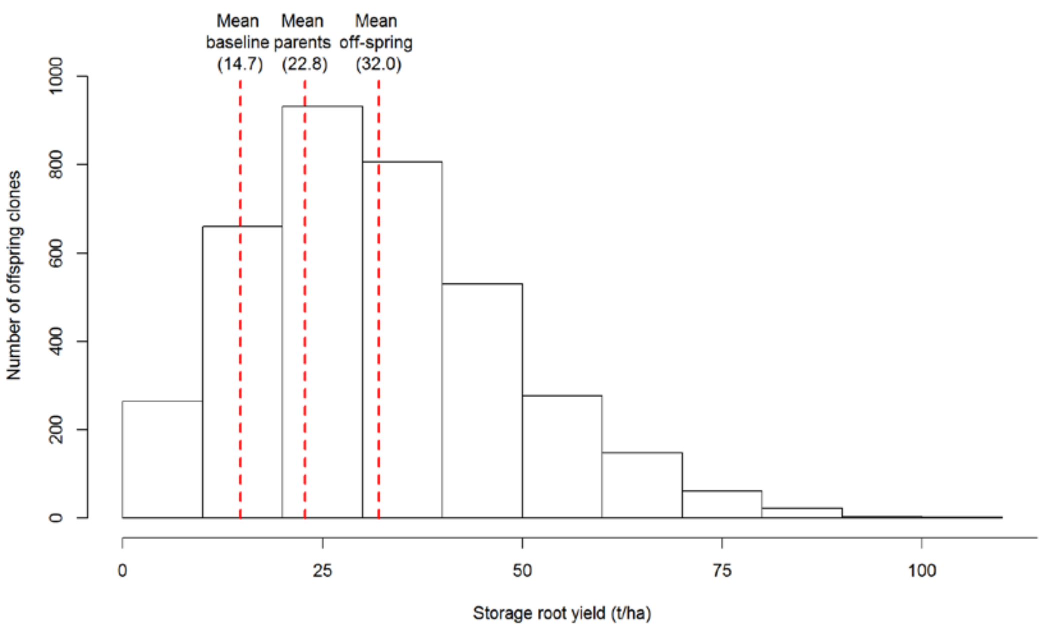

Fig. 6. Genetic gain (GG) for storage root yield by genepool separation and one complete reciprocal recurrent selection cycle estimated in population NSSP at two locations in Peru / Canete – arid pacific coast / Satipo – humid tropics [Mean baseline (14.7 t/ha), 80 clones each clone in 8 one-meter row plot replications, selected fraction in baseline PJ = 0.10 and PZ = 0.16; mean parents (22.8 t/ha), 53 clones each clone in 8 one-meter row plot replications; mean offsprings (32.0 t/ha), 3742 H1 hybrid clones; total GG: 117.7%; heterosis increment in H1: 40.4%, estimated gain by one reciprocal recurrent selection cycle: 55.1%].

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Sensorial evaluation for low sugar H1 hybrid population (about 5000 genotypes) – note: sugar contents before and after cooking can be extremely different

CIP 2014-2019 / SASHA phase 2
Genetic Grains & Heterosis increments in wide adaptation & earliness hybrid 1 population

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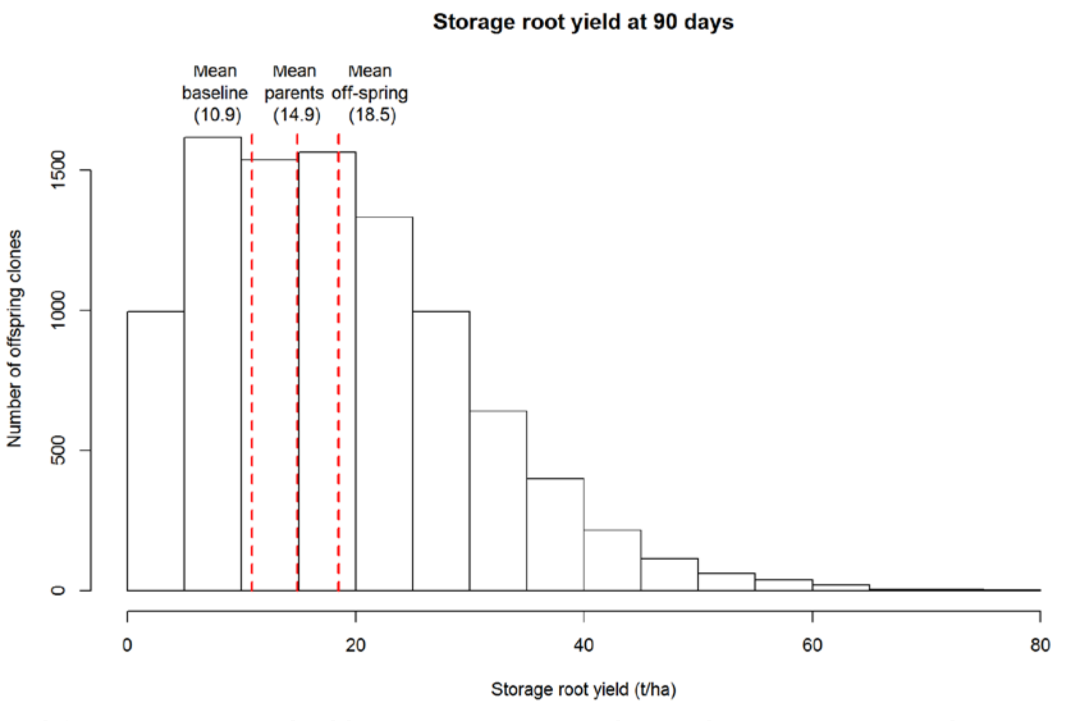

Fig. 7. Genetic gain (GG) for storage root yield by genepool separation and one complete reciprocal recurrent selection cycle estimated in population WAEA 90 days harvest at two locations in Peru / Canete – arid pacific coast / Satipo – humid tropics [[Mean baseline (10.9 t/ha), 80 clones each clone in 8 one-meter row plot replications, selected fraction in baseline PJ = 0.56 and PZ = 0.55; mean parents (14.9 t/ha), 84 clones each clone in 8 one-meter row plot replications; mean offsprings (18.5 t/ha), 9881 H1 hybrid clones; total GG: 69.7%; heterosis increment in H1: 27.6%, estimated gain by one reciprocal recurrent selection cycle: 36.7%].

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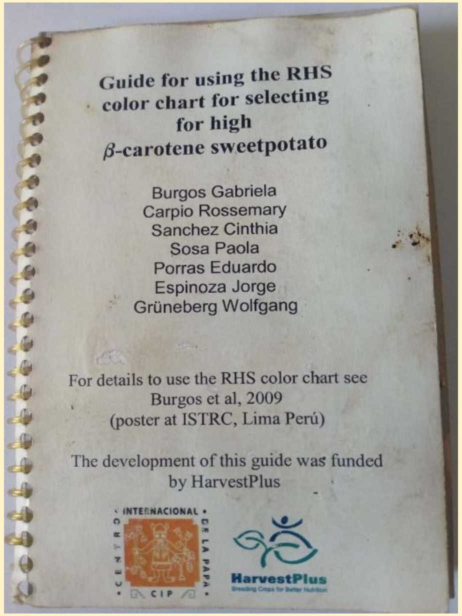
CIP 2014-2019 / SASHA phase 2
Genetic Grains & Heterosis increments in wide adaptation & earliness hybrid 1 population

Canete / Peru 2017 (temperate arid pacific coast) – Planting of H1 for wide adaptation and earliness (N > 16,000) in double plots for early (90 days) and for normal harvest (120 days)

CIP 2014-2019 / SASHA phase 2
Genetic Grains & Heterosis increments in wide adaptation & earliness hybrid 1 population

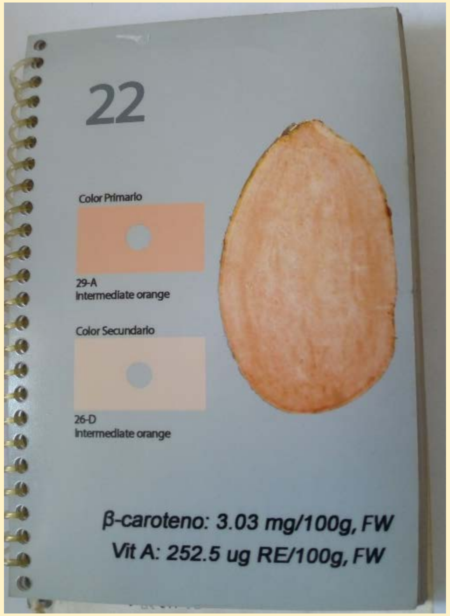


Guide for using the RHS color chart for selecting for high β-carotene sweetpotato

Burgos Gabriela
Carpio Rossemary
Sanchez Cinthia
Sosa Paola
Porras Eduardo
Espinoza Jorge
Grüneberg Wolfgang

For details to use the RHS color chart see Burgos et al, 2009 (poster at ISTRC, Lima Perú)

The development of this guide was funded by HarvestPlus



22

Color Primario

29-A
Intermediate orange

Color Secundario

26-D
Intermediate orange

β-caroteno: 3.03 mg/100g, FW
Vit A: 252.5 ug RE/100g, FW

Beta-carotene color charts – all clones in populations are evaluated for dry matter and by color charts in quality lab San Ramon

Hybrid Breeding Schemes / Heterosis Exploiting Breeding resulted in production of Elite Crossings

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Table 1: Hybrid population H0 (PH15 / USAID) family lsmean estimates for “Elite OFSP Hybrid Crosses” for 100 day growing periods.

Cross combination PJ x PZ	Number of commercial root per plant	Storage root yield (t/ha)	Foliage yield (t/ha)	Root dry matter (%)
Low dry matter elite OFSP cross combinations				
PJ05.124-PZ08.038	3.50	27.4	30.0	25.7
PJ05.120-PZ08.011	3.31	31.0	16.1	25.8
PJ05.130-PZ08.038	2.83	27.9	25.2	26.2
PJ05.213-PZ08.038	2.78	24.3	40.3	27.4
PJ05.213-PZ08.090	2.70	25.7	42.3	27.3
PJ07.265-PZ08.011	2.68	20.1	30.7	28.0
High dry matter elite OFSP cross combinations				
PJ07.061-PZ08.038	2.67	27.8	31.3	29.8
PJ07.061-PZ06.085	2.62	19.5	30.0	28.7
PJ07.690-PZ06.304	2.17	16.3	29.8	29.7
PJ07.079-PZ06.304	2.17	20.5	40.4	28.3
PJ05.213-PZ08.153	2.15	25.8	23.8	32.3
PJ05.064-PZ08.153	2.00	17.4	14.7	31.6

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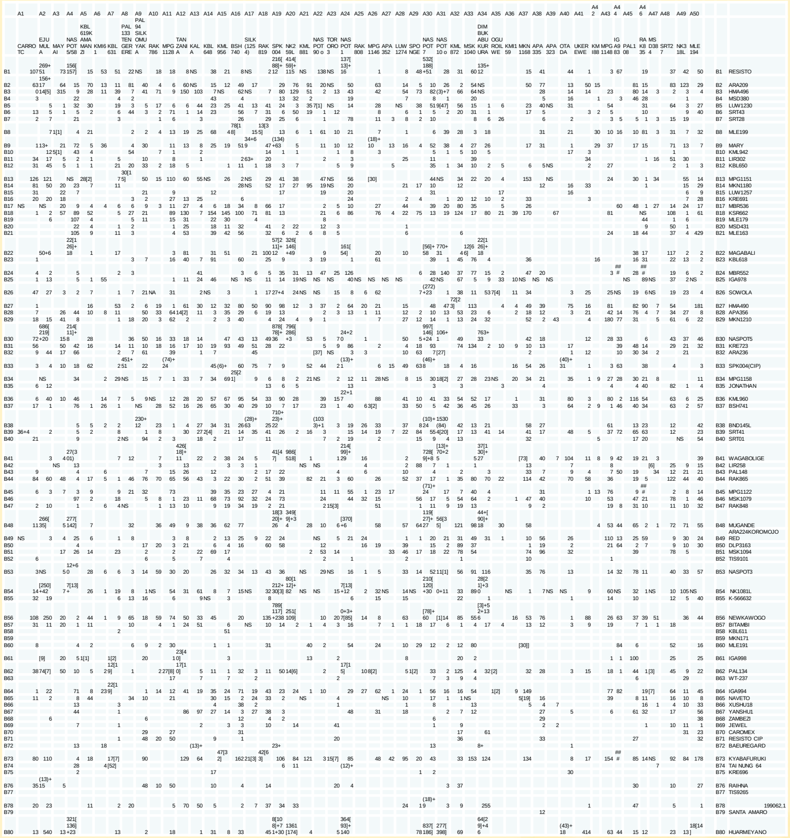
UG H0 population

Table 10. True seed for 50 A parents x 80 B parents (No. of families with at least 6 seed = 41.2%)



	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34	A35	A36	A37	A38	A39	A40	A41	A42	A43	A44	A45	A46	A47	A48	A49	A50		
	CARROTC	EJUMULA	MAYAI	NASPOT 5/58	KBL 619K AMAMANZI	KMI61	KBL631	PAL 133 TENGERERE	PAL 94 SILK OMUYAKA	RAK786	MPG1128	TANZANIA	KALA	KBL648	KML956	BSH740	SILK (1254)	RAK819	SPK004	NK259L	KML881	NASPOT 90 o	TORORO3	NASPOT1	RAK808	MPG1146	APA352	LUW1274	SPONGE	NASPOT7	NASPOT 10 o	KML872	MSK1040	DIMBUKABUKURURA	OGUROILWE	KMI159	MKN1168	APA335	APA323	OTADA	UKEREWE	KMI88	MPG1148	IGA983	PAL108	RAK835	MSD384	SRT27	NK318L	MLE194		
B1	107	269+51	73	156[157]	15	53	51	22	NS	18	18	8	NS	38	21	8	NS	2	216[88]+12	414[59]+115	NS	138	NS	137[13]+16		1		8	48	532[188]+51	28	31	60	135+12			15	41		44	1		3	67		19		37	42	50	B1	RESISTO
B2	63	156+17	64	15	70	13	11	81	40	4	6	60	NS	15	12	49	17		29	76	91	20	NS	50		63		14	5	10	26	2	54	NS			50	77		13	50	15			81	15		83	123	29	B2	ARA209
B3	0	14[5]	315	9	28	11	39	7	41	71	9	150	103	7	NS	62	NS	7	80	129	51	2	13	43		42		54	73	82	(3)+7	66	64	NS				28		14	14		23		80	14	3	2	3	4	B3	HMA496
B4	3			22			4	2						43		4			13	32	2			19				7		8	1		20					5		16		1		3	46	28			1		B4	MSD380
B5		5	1	32	30		19	3	5	17	6	6	44	23	25	41	13	41	24	3	35	7[1]	NS	14		28		NS	38	51	9[47]	56	15	1	6		23	40	NS	31			54			31		64	3	27	B5	LUW1230
B6	13	5	1	5	2		6	44	3	2	71	1	14	23		56	7	31	6	50	19	1	12			8		6	1	5	2	20	31	1			17	5			3	2	5			10			9	40	B6	SRT43
B7	2	7		21			3			1	6		3			26		29	25	6		1		78		11	3	8	2	10			8	6	26			6		2			3	5	5	1	3	15	19		B7	SRT28
B8		7	1[1]	4	21			2	2	4	13	19	25	68	4	78[18]	15	13[35]	13	6	1	61	10	21		7		1		6	39	28	3	18				31		21		30	10	16	10	81	3	31	7	32	B8	MLE199
B9	1	13+	21	72	5	36		4	30		11	13	8	25	19	51	34+69	47	(134)+63	5		11	10	12		(18)+10	13	16	4	52	38	4	27	26			17	31		1		29	37		17	15		71	13	7	B9	MARY
B10		12	5[1]	43	4			54		7	1		2					14	1	1			1	8		3				5	1	5	10	5						17	3							1			B10	KML942
B11	34	17	5	2	1		5		10		8		1			2	63+	20				2		3				25		11			39								34					1	16	51	30		B11	LIR302
B12	31	45	5	1	1		21	20	33	2	18	5			1	11	1	18	3	7			5	9			5			35	1	34	10	2	5		6	5	NS		2		27					2	1	3	B12	KBL650
B13	126	121		NS	28[2]		7	30[15]	50	15	110	60	55	NS	26	2	NS	29	41	38		47	NS	56		[30]				44	NS	34	22	20	4		153		NS				24		30	1	34		55	14	B13	MPG1151
B14	81	50	20	23	7		11									28	NS	52	17	27	95	19	NS	20				21	17	10		12						12		16	33					1			15	29	B14	MKN1180
B15	31		22	7					21		9			12					17			19		20						31					17					16									6	9	B15	LUW1257
B16	20	20	18					3	2		27	13	25			6								24				2	4		1	20	12	10	2		33				3								7	28	B16	KRE691
B17	NS	NS	20	9	4	4	6	6	9	3	11	27	4	6	18	34	8	66	17			2	5	10		27		44		39	20	80	35		5		26							60	48	1	27	14	24	17	B17	MBR536
B18	1	2	57	89	52		5	27	21		89	130	7	154	145	100	71	81	13			21	6	86		76	4	22	75	13	19	124	17	80	21	39	170		67				81			NS		108	1	61	B18	KSR662
B19		6		107	4			5	11		15	31		22	30		4					8																								44		1		6	B19	MLE179
B20				22	4		1	2			1	25		18	11	32		41	2	22		12	3					1																		9		50		1	B20	MSD431
B21				105	9		11	3			4	53		39	42	56		32	6	2	6	8	5					6				6											24		18	44		37	4	429	B21	MLE163
B22		50+6		22[126]+18	1		17				3	81		31	51		21	100	57[211]+12	326[146]+49		9		161[54]		20		10		[56]+58	770+31	4	12[66]	22[126]+18											38	17		117	2	2	B22	MAGABALI
B23	1							3	7		16	40	7	91		60		25	9		3	19		1		61				39	1	45	76	4			36					16			16	31		22	13	2	B23	KBL618
B24	4	2		5			2	3					41			3	6	5	35	31	13	47	25	126					6	28	140	37	77	15	2		47	20					3	###	28	###		19	6	2	B24	MBR552
B25	1	13		5	1	55					1	11	24	46		NS	NS	11	14	19	NS	NS	NS	40	NS	NS	NS	NS		42	NS	67	5	9	33	10	NS	NS	NS						NS	89	NS	37	2	NS	B25	IGA978
B26	47	27	3	2	7		1	7	21	NA	31		2	NS	3		1	17	27+4	24	NS	NS	15	8	6	62			7	(272)+23	1	38	11	53	7[4]	11	34			3	25		25	NS	19	6	NS	19	23	4	B26	SOWOLA
B27	1				16		53	2	6	19	1	61	30	12	32	80	50	90	98	12	3	37	2	64	20	21		15		48	47	72[23]	113		4	4	49	39		75	16		81		82	90	7	54		181	B27	HMA490
B28	7		26	44	10	8	11		50	33	64	14[2]	11	3	35	29	6	19	13			2	3	13	1	11		12	2	10	13	53	23	6		2	18	12		3	21		42	14	76	4	7	34	27	8	B28	APA356
B29	18	15	41	8			1	18	20	3	62	2		2	3	40		4	24	4	9	1				7		27	12	14	1	13	24	32			52	2	43		4		180	77	31		5	61	6	22	B29	MKN1210
B30	72	686[219]+20	15	214[11]+8	28			36	50	16	33	18	14		47	43	13	49	878[78]+36	796[286]+3	53	5	7	24+20	1			50	5	997[146]+24	106+1		49	763+33			42	18			12		28	33		6		43	37	46	B30	NASPOT5
B31	56		50	42	16		14	11	10	18	16	17	10	19	93	49	51	28	22			5	9	86		2		4	18	93		74	134	2	10	9	10	13		17				39	48	14		29	21	32	B31	KRE723
B32	9	44	17	66			2	7	61		39		1	7			45					[37]	NS	3	3			10	63	7	[27]						2			1	12			10	30	34	2		21		B32	ARA236
B33	3	4	10	18	62		2	451+51	22		(74)+24			45	(6)+	60	75	7	9		52	44	2	(13)+1		6	15	49	63	(46)+8	18	4	16			16	54	26		(40)+31	1		3	63		38		4		3	B33	SPK004(CIP)
B34		NS		34		2	29	NS	15	7	1	33	7	34	69	25[21]	9	6	8	2	21	NS	2	12	11	28	NS	8	15	30	18[2]	27	28	23	NS	20	34	21		35	1	9	27	28	30	21	8			11	B34	MPG1158
B35	6	12																13	6	5				13						3		3			3			4					4		4	40		82	1	4	B35	JONATHAN
B36	6	40	10	46		14	7	5	9	NS	12	28	20	57	67	95	54	33	90	28		39	15	22+17		88		41	10	41	33	54	52	17		1		31		80	3		80	2	116	54		63	6	25	B36	KML960
B37	17	1		76	1	26	1		NS	28	52	16	26	65	30	40	29	10	7	17		23	1	40	6	3[2]		33	50	5	42	36	45	26		33		3		64	2	9	1	46	40	34		63	2	57	B37	BSH741
B38				5	5	2	2		230+12	23	1	4	27	34	31	26	(28)+63	25	710+23)+22			(1033)+1	3	19	26	33		37	8	(10)+24	1530 (84)	42	13	21			58	27					61		13	23		12		42	B38	BND145L
B39	36+4	2		5	2		8		1	8		30	27	2[4]	21	14	35	41	26	2	16	3		15	14	19	7	22	84	55	4[20]	17	13	41	14		41	17		48	5		37	72	65	63		12		23	B39	SRT41
B40	21			9			2	NS	94	2	3		18	2		17		11				7	2	19		2			15	9	4	13					32					5			17	20			NS	54	B40	SRT01
B41		3	4	27(301)			7	12		7		426[18]+11	22	2	38	24	5		41[47]	986[518]	1		1	214[99]+29	16			2		728[9]+8	[13]+70+25		5	37[130]+27			[73]	40	7	104	11	8	9	42	19	21	3			39	B41	WAGABOLIGE
B42			NS	13						3		13			3	3	1				NS	NS			4			2	88	7	1		1				13			7			8				[6]	25	9	15	B42	LIR258
B43	9			4		6			7		15	26		12			2	17	22				4		6			10		4		2		3			33	7		9	4		7	50	19		34	12	21	21	B43	PAL148
B44	84	60	48	4	17	5	1	46	76	70	65	56	43	3	22	30	2	51	39		82	21	3	60		26		52	37	17	1	35	80	70	22		114	42		70	58		36		19	5		122	44	40	B44	RAK865
B45	6	3	7	3	9		9	21	32		73			39	35	23	27	4	21			11	11	55	1	23	17			(71)+24	17	7	40	4				31			1	13	76		9	###		2	8	14	B45	MPG1122
B46				97	2		18		5	8	1	23	11	68	73	92	32	24	73			24		44	32	15			56	17	5	54	64	2		1	47	40			10		53		47	21		78	1	46	B46	MSK1079
B47	2	10		1		6	4	NS		1	13	10		9	19	34	19	2	21			2	15[3]			51			1	11	9	19	13				9	2					19	8	31	10		11	10	32	B47	RAK848
B48	11	266[35]	5	277[142]	7			32		36	49	9	38	36	62	77			18[320]+26	349[9]+34	28	10	6	[370]+6		58		57	64	119[27]+27	56[35]	121	98	44+[90]+18	30		58					4	53	44	65	2	1	72	71	55	B48	MUGANDE
B49	NS	3	4	25	6		1	8			3	8		2	13	25	9	22	24			NS	5	21	24			1	1	20	21	31	49	31	1		10	56		26			110	13	25	59		9	30	24	B49	ARA224KOROMOJO RED
B50				4					17	20	3	21		6	4	16		60	58			12			16	19		39		15	2	89	37				1	19		2			21	64	2	7		9	10	30	B50	DLP3163
B51			17	26	14		23		2		2		22	69	17						2	53	14				33	46	17	18	22	78	54				74	96		32					39			78	5		B51	MSK1094
B52	6								6		5		7		4							2		1				2				1					10						1								B52	TIS9101
B53	3	NS	5	12+60	28	6	6	3	14	59	30	20		26	32	34	13	43	36		NS	29	NS	16	1	5		33	14	52	11[1]	56	91	116			35	76		13			14	32	78	11		40	33	57	B53	NASPOT3
B54	14	[250]+42	7	7[13]+	26	1	19	8	1	NS	54	31	61	8	7	15	NS	32	212+30[3]	80[112]+82	NS	NS	15	7[13]+12	2	32	NS	14	NS	210[120]+30	0+11	33	89	28[21]+30		NS	1	7	NS	NS	9		60	NS	32	1	NS	10	105	NS	B54	NK1081L
B55	32	19					6	13	16		6		9	NS	3			8						6		15		15				22		1						1			14		10			12	5	40	B55	K-566632
B56	108	250	20	2	44	1	9	65	18	59	74	50	33	45		20		135	789[117]+238	251[109]		10	20	0+3+7[85]	14	8		63		[78]+60	[1]14	85	55	[3]+52+136		16	53	76		1	88		26	63	37	39	51		36	44	B56	NEWKAWOGO
B57	31	11	20	1	11			10		4	1	24	51		6		NS	10	14	2	1	4	3	16		7	1	1	18	17	6	1	4	17	4		13	12		3	9		19		7	1	1	18			B57	BITAMBI
B58							2								51																																				B58	KBL611
B59																																																			B59	MKN171
B60	8			4	2			6	9	2	30			1	1			31			40	2		54		24		10	29	12	2	12	80				[30]]							84	6			52		16	B60	MLE191
B61		[9]	20	5	1[1]		1[2]		20		1	23[40]			3						13		2					8				20	2										1	1	100			25		25	B61	IGA998
B62	38	74[7]	50	10	5	2	12[19]	1		2	27[8]	17[10]	5	11	1	32	3	11	50	14[6]		2		17[15]	10	8[2]		5	1[2]	33	2	125	4	32	[2]		32	28		3	15		18	1	44	1	[3]	45	9	22	B62	PAL134
B63											17		7		7		2						2							7	3	9	4												6				29		B63	WT-237
B64	1	22		71	8	23	22[19]		1	14	12	41	19	35	24	71	19	43	23	24	1	10		29	27	62	1	24	1	56	16	16	54		1[2]	9	149						77	82		19	[7]	64	11	45	B64	IGA994
B65	11	2		8	44			34	10		21			30	15	2	24	33	2		NS		4				NS	10		17	1	1	NS				5[19]	16					39		8	11		16	10	8	B65	NAVETO
B66				13			3							4		38	2						1					1		8			13				5	4	7							16	1	4	10	33	B66	XUSHU18
B67				44			1					86	97	27	14	3	27	38	3					48		31		18			2	7	12					27		5			6		61	32		17		56	B67	YANSHU1
B68		6							6							12		4	2											6								29												38	B68	ZAMBEZI
B69				7			1						2		3	3		10		14			41							1		9						2	2							1		10	11	1	B69	JEWEL
B70									29		27					31																17		61															31	23	B70	CAROMEX
B71							1		48	20	50			9		1							20									36						33							27					32	B71	RESISTO CIP
B72				13		18							(13)+						23+											13				8+						1											B72	BAEUREGARD
B73	80	110		4	18		17[7]		90			129	64		47[32]	162	21[3]	42[63]	106	84	121	3	15[7]	85		48	42	95	20	43		33	153	124			134			8	17		154	###	85	14	NS	92	84	178	B73	KYABAFURUKI
B74				28		4	[52]												6	11				(12)+																							7				B74	TAI NUNG 64
B75				2										17															1	2										30											B75	KRE696
B76	35	(13)+15	5						48	10	50			10		4		14					20	4							3	37													30			10		27	B76	RAIHNA
B77																																																			B77	TIS9265
B78	20	23			11		2	20			5	70	50	5		2	7	37	34	33								24	1	(18)+9	3	9		255							1				47			5		1	B78	199062,1
B79																																						12													B79	SANTA AMARO
B80	13	540	13	321[136]+23			13		2		18		1	31	8	33		45	8[108]+71+30	1361[174]	4		5	364[93]+140					78	837[186]	277[398]	69		64[29]+46						(43)+18	414		63	44	15	12		23	18[1413]		B80	HUARMEYANO

CIP 2013-2018

Sweetpotato Action for Security and Health in Africa

Additional lessons learned:

- Varcomp general combining ability (GCA) considerably much larger specific combining ability (SCA) / this makes happy breeders;
- Potential testers found => several cross combinations and high GCA (2 in H0 SASHA, 6 in H0 USAID);
- Logistics and operation required special field design – Westscott (1982) design now used (for safety reasons), clones per family within 8 -16 without rep., parents in 6-8 replications;
- SSR markers separate genepools quite well – a) PJ and PZ pools in Peru and b) UG_A and UG_B in Uganda;

Future:

- Implementation of Hybrid Breeding Scheme and Heterosis Exploiting Breeding Scheme on Breeding Platform;
- Elite crossing true seed dissemination (on basis of "Super Parents");
- Elite crossing will become our target to apply genome wide prediction + marker assisted selection – this is within the logistical and operational capacity (1000 to 2000 clones)

SPVD – Frist population VJ08

- 104 OFSPs x DLP3163 (CIP420269)
  - Parental material OFSP
    4 of 104 Jewel clones were resistant to SPCSV (frequency 0.0385)
  - Offsprings – 718 clones
    40 of 718 were resistant to SPCSV (frequency 0.057)

Family	Resistance frequency
PJ05.072 x DLP3163	5 of 12 (0.42)
PJ05.090 x DLP3163	3 of 6 (0.50)

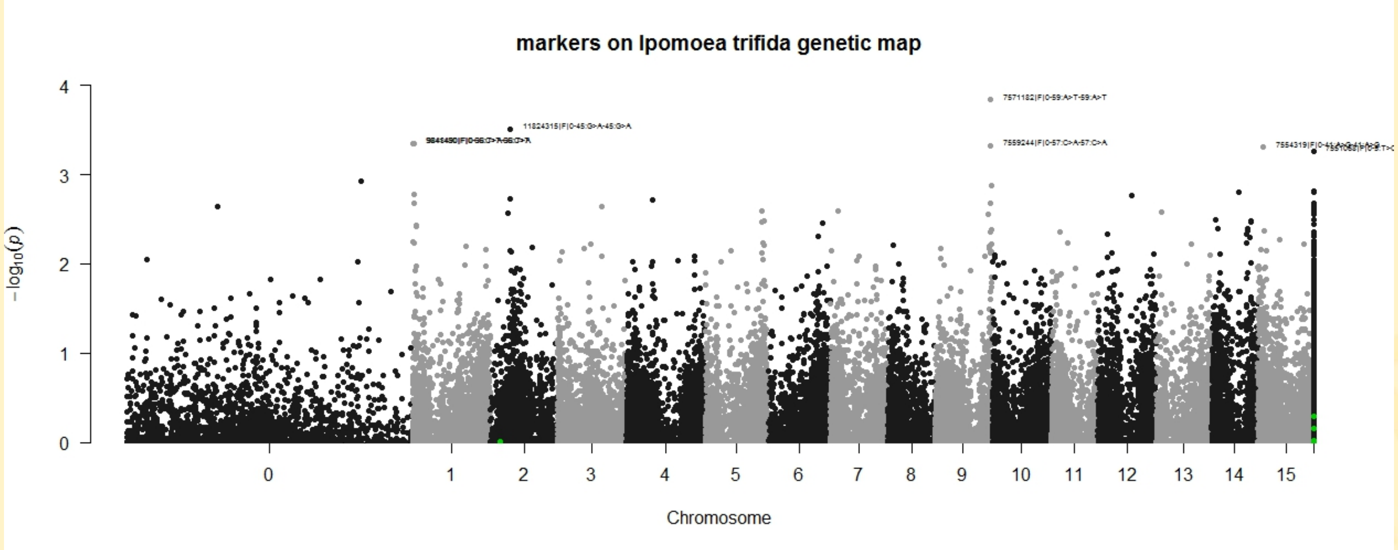
Two small sets of clones were formed (a resistant set [VJ08.330 x VJ08.330, VJ08.330 x PJ05.064] and susceptible set of clones, each comprising 12 clones) and marker association was performed on them.

- AFLP: E44M34.533, E33M48.460, E36M34.400, E33M48.343, and E39M32.440, band absent in the resistant bulk and present in the susceptible bulk; E39M34.156, band was present in the resistant bulk and absent in the susceptible bulk.
- SSR: IBS204-172, IBS169-162, Ib-286-125, IbJ559-262, IbJ559-269, IbJ116a-229, and IBS149-225.
- DArT: 758044, 7563062, 7572542, 753123, and 7574925.

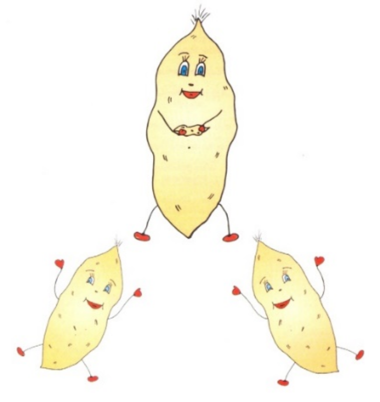
SPVD – Second population VZ08

- Screening for resistance
    - Sweetpotato plants were grafted with *I. setosa* that carried SPFMV and SPCSV, in San Ramon screenhouse.
    - DAS and TAS Elisa tests were performed on sweetpotato clones to diagnose virus susceptibility.
    - Serological test was selected because it requires less laboratory equipment compared to other methods.

- Marker association VZ08
  - From ELISA results, we selected contrasting groups for SPCSV resistance (25 resistants and 31 susceptible).
  - We obtained DArT markers from 325 genotypes. Seven markers were identified to show correlation with SPCSV resistance.



- RESULTS
  - With DArT markers we have found in total 13 associations and only 2 in validation (both populations VJ08 and VZ08) - test these markers in a third population.
  - Currently, we have two experiments in two locations (San Ramon and Satipo) for selected clones of the VZ08 population.



Thank-you for your Attention