

OUTPUT 4
Development of genetic stocks and improved gene pools adapted to the sub-humid environments.

Activity 4.1. Evaluations and selections in the sub-humid environment.

For logistic reasons, improvement activities developed for several regions of the Northern Coast of Colombia were centralized initially in Barranquilla. Many of the materials evaluated there can then be transferred to the more humid region in the Departments of Córdoba and Sucre, and to the Middle Magdalena (Department of Santander). Table 4.1 lists the most relevant trials, whereas the other tables show results specific to each one.

Table 4.1. Trials conducted in the sub-humid ecosystem (North Coast of Colombia) in the 2003-2004 cycle.

Type of Trial	Location	Genotypes (# plants)	Reps	Observations
Clonal evaluation trial	Santo Tomás	1157 (7)	3	Tables 4.2-4.4
F1C1 nursery	Santo Tomás	376 (1)	1	--
Preliminary yield trial 1 (2002)	Santo Tomás	81 (10)	3	See Table 4.5
Preliminary yield trial 2 (2002)	Santo Tomás	64 (10)	3	See Table 4.6
Preliminary yield trial 3 (2002)	Santo Tomás	72 (10)	3	See Table 4.7
Preliminary yield trial 4 (2003)	Santo Tomás	110 (10)	3	See Table 4.8
Preliminary yield trial 5 (2003)	Santo Tomás	110 (10)	3	See Table 4.9
Preliminary yield trial 6 (2003)	Santo Tomás	110 (10)	3	See Table 4.10
Preliminary yield trial 7 (Diallel)	Santo Tomás	60 (10)	3	See Table 4.11
Advanced yield trial	Santo Tomás	35 (20)	3	See Table 4.12
Advanced yield trial	Palapa	35 (20)	3	See Table 4.12
Advanced yield trial	La Ester	35 (20)	3	See Table 4.12
Regional Trial	La Ester	30 (25)	3	See Table 4.13
Selection criteria special study	Caracolí	8 (25)	3	See Table 4.14
Selection criteria special study	Laruaco	8 (25)	3	n.a.
Selection criteria special study	Pitalito	8 (25)	3	See Table 4.14
Selection criteria special study	Santo Tomás	8 (25)	3	See Table 4.14
Multiplication promising clones	Various	615	1	--
Multiplication elite clones	Pitalito	Various	1	--
Multiplication elite clones	Santo Tomás	Various	1	--

As mentioned in the previous Output (Table 3.5) a total of 4452 seeds were germinated and 3091 seedlings from these botanical seeds (targeting this particular environment) were transplanted at CIAT-Palmira in an isolated field. The planting of the *F1* stage is isolated to reduce as much as possible infection by diseases that can be found at later stages of the evaluation process. Seedlings from botanical seed are considered to be disease-free and efforts are made to maintain this condition for as long as it can possibly be done. Enough vegetative cuttings from 1189, 10-months old plants (grouped in 57 families) from the *F1* nursery planted the previous year could be obtained and planted in the **Clonal Evaluation Trial (CET)** for the sub-humid environment in Santo Tomás (Atlántico Department) on June 19, 2004. The trial will be harvested in April-May 2005. A second *CET* was planted with the 376 *F1C1* genotypes, which did not produce the number of stakes required and, therefore,

were grown again during the previous cycle (See Table 4.1).

Clonal Evaluation Trials are very large experiments around one hectare in size. A major constraint in their evaluation is the experimental error associated with the unavoidable variation in environmental conditions in such a large experimental plot. Because this is the first evaluation and selection stage (See Output 3) only 7 stakes are available from each genotype. Replication of each clone, therefore, is difficult to implement. On the other hand clones are grouped in either full- or half-sib families. Since many clones are generally available from each family they are randomly allocated in one of three blocks in which the field is divided. In other words instead of planting all the clones from a given family together one after the other, they are split in three groups, which are planted in the three blocks the entire evaluation is divided into (Figure 4.1). This approach allows for two interesting advantages:

- a) There is a replication effect for the families because all the clones from a given family are scattered in three “repetitions” in the field. The averages from all these clones are less affected by the environmental variation in such a large experiment.
- b) Selection is made within each block. This is similar to the stratified mass selection suggested by Gardner (See Activity 3.5, page 3.15). This approach effectively overcomes the environmental variation that can be measured by comparing the means of each block.

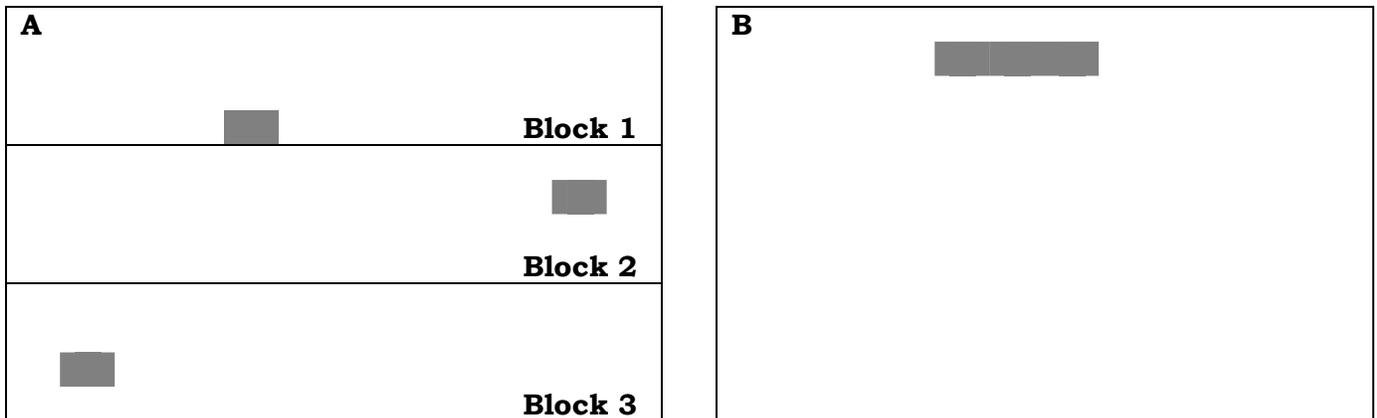


Figure 4.1. Advantage of splitting each family of clones in three groups that were randomly assigned to each of three blocks in the *CET*. (A= current procedure; B= previous situation).

Because all the clones from the *CET* were divided, the average performance of each family were more precisely estimated, since each family was scattered in three different parts of the field, whereas before it was concentrated in just one sector (Figure 4.1). As a consequence, the estimates of GCA for each family is much more precise.

A summary of the results from the *CET* for the Sub-Humid environment harvested this year is presented in Table 4.2. The 1157 clones included in the *CET* were allocated in three blocks with 388, 386 and 383 clones each one, respectively. Checks were also included in each block. Table 4.2 provides information on the averages for each of the three blocks. The variation among these three blocks is an error that eventually affects the selection process. By selecting within each block, however, this environmental effect could be effectively eliminated. Since selection indexes were calculated within each block there is no major variation for this variable across blocks. On the other hand the average fresh root yields were 18.7, 27.1, and 29.7 t/ha respectively for Blocks 1, 2 and 3. This highlights the large environmental variation that is overcome by stratifying the selection within each block.

Table 4.2. Results from the **Clonal Evaluation Trial** divided into three blocks and conducted in Santo Tomás (Atlántico Department). Statistics of the 60 clones selected and all the clones evaluated in each block are presented.

	Plant type (1-5)	Fresh root yield (t/ha)	Foliage yield (t/ha)	Harvest Index (0-1)	DMC-1 (%)	DMC-2 (%)	Dry root yield (t/ha)	Selection Index
60 selected clones from Block-1								
Minimum	1.00	17.2	9.6	0.40	28.3	26.6	5.8	16.5
Maximum	4.00	42.8	46.0	0.76	38.5	35.7	13.0	47.7
Average	2.00	26.0	23.4	0.53	34.4	32.0	8.3	24.9
St.Deviation	0.69	5.0	7.0	0.08	2.2	2.2	1.4	7.9
Performance of the 388 clones evaluated in Block -1								
Minimum	1.00	0.0	2.7	0.00	19.9	0.0	0.0	-149.3
Maximum	5.00	42.8	55.1	0.82	38.5	36.3	13.0	47.7
Average	2.58	18.7	24.7	0.43	32.6	29.8	5.6	0.0
St.Deviation	1.03	6.0	7.6	0.10	2.9	3.6	1.9	18.6
60 selected clones from Block -2								
Minimum	1.00	18.8	8.3	0.40	26.1	24.6	6.4	17.3
Maximum	5.00	42.5	40.9	0.74	39.8	37.4	11.2	45.4
Average	2.22	27.1	23.3	0.54	34.7	31.7	8.5	23.7
St.Deviation	0.78	4.5	7.0	0.07	2.5	2.5	1.1	6.2
Performance of the 386 clones evaluated in Block -2								
Minimum	1.00	1.6	1.3	0.08	23.9	20.1	0.4	-59.6
Maximum	5.00	42.5	43.4	0.88	40.7	38.0	11.2	45.4
Average	2.64	19.4	20.9	0.49	32.7	29.4	5.7	0.0
St.Deviation	0.91	6.2	7.6	0.10	3.0	3.4	1.9	16.4
60 selected clones from Block -3								
Minimum	1.00	20.9	9.8	0.43	26.7	25.4	6.8	14.2
Maximum	4.00	43.7	37.7	0.73	38.5	39.6	12.7	39.6
Average	2.15	29.7	23.8	0.56	34.2	31.5	9.3	22.3
St.Deviation	0.90	5.8	6.5	0.06	2.3	2.6	1.4	5.9
Performance of the 383 clones evaluated in Block -3								
Minimum	1.00	1.8	1.0	0.10	19.0	0.0	0.0	-68.8
Maximum	5.00	43.7	48.6	1.00	38.7	39.6	12.7	39.6
Average	2.52	20.7	19.6	0.52	32.5	29.3	6.1	0.0
St.Deviation	1.07	7.1	7.7	0.09	2.9	3.8	2.2	16.2

In Table 4.3 the size (number of clones) and the number of selected clones from each family has been consolidated. This data has been obtained by combining information of the three blocks in which the *CET* was divided into. The average selection index has also been included. The use of selection index has been already described in Output 3.

Family CM9955 had 11 clones scattered in the three blocks of the *CET*. Eight of these clones (73%) were selected. The average selection index for this family was 13.40. A family with an average performance would have a selection index around zero. Positive selection indexes mean an average performance better than the mean of the population. A negative selection index suggests a performance below the mean of the population. In the case of family CM995, it is obvious that the general performance of that family was outstanding because its selection index (averages across the 11 clones that conformed this family) was 13.40.

Table 4.3. Results from the **Clonal Evaluation Trial** grown in Santo Tomás (Atlántico Department). The results from all the clones from a given family have been grouped. Therefore family data is combined across the three blocks in which the trial was divided into.

Family	Size	# selected clones	Selection Index	Family	Size	# selected clones	Selection Index
CM 9955	11	8	13.40	GM 410	18	2	1.22
CM 9913	9	5	12.42	GM 466	39	4	-5.12
GM 249	43	23	15.68	SM 3063	32	3	-5.75
CM 9923	2	1	17.55	GM 413	13	1	-3.71
GM 288	2	1	12.04	GM 468	26	2	-3.52
GM 462	34	16	13.34	GM 266	42	3	3.25
CM 9907	12	5	11.30	CM 9914	17	1	6.97
GM 248	12	5	12.23	SM 3062	37	2	1.12
CM 9946	39	16	12.47	CM 9904	19	1	2.13
CM 9958	8	3	6.27	GM 443	22	1	-5.78
CM 9924	15	5	5.16	SM 3054	44	2	-5.27
GM 262	12	4	3.88	GM 546	36	1	-9.48
CM 9926	11	3	11.26	CM 8379	8	0	-8.55
SM 3061	26	6	5.12	CM 8488	7	0	-3.82
CM 9910	22	5	7.98	CM 9106	4	0	0.25
CM 9945	22	5	4.62	GM 383	10	0	-12.19
GM 408	28	6	5.31	GM 385	15	0	-3.56
SM 3058	29	6	1.55	GM 428	23	0	-10.63
GM 579	26	5	-0.31	GM 436	31	0	-14.14
CM 9904	24	4	4.28	GM 439	27	0	-13.58
CM 9957	18	3	6.57	GM 451	25	0	-3.84
SM 2621	19	3	0.63	GM 456	38	0	-12.29
GM 406	45	6	1.06	GM 521	16	0	-7.58
GM 409	15	2	-9.87	GM 549	7	0	-15.31
GM 465	30	4	-0.76	GM 578	10	0	-7.31
GM 389	8	1	6.71	SM 2750	11	0	-10.02
SM 3067	35	4	-4.09	SM 3052	5	0	-14.76
CM 9832	18	2	5.73	Total	1157	180	0.37

Large families such as GM 249 had a high proportion of their clones selected (23 out of 43). At the bottom of the right side of Table 4.3 concentrate the worst performing families. For instance Family GM 456 had 38 clones scattered in the three blocks of the *CET*. None of them was selected. As expected the average selection index for this family was negative (-12.29).

The information from Table 4.3 can be further consolidated around the average performance of each progenitor used to generate the *CET*. This is so because each progenitor can be used to produce more than one family. For instance Clone SM 1411-5 (Table 4.4) was used as one of the progenitors in seven full-sib families. Table 4.4 provides information for the most important characteristics of the progenies from each parent. This information is very closely related to the GCA estimates and reflects the breeding value of each progenitor. This information is very useful for defining the parents to be included in the crossing nurseries in the future.

Table 4.4. Results from all the progenies of a given clone evaluated in the **Clonal Evaluation Trial**. These results give an approximation of the breeding value of each parent involved in this trial.

Progenitor	# Fam.	# clones	Selec. clones	Plant type (1-5)	FRY (t/ha)	FFY (t/ha)	HI (0-1)	DMC (%)	DMY (t/ha)	Sel. Ind.
SM 1665-2	2	55	28	3.0	25.5	17	0.61	30.7	7.54	14.0
SM 1411-5	7	138	53	2.4	21.9	22	0.51	32.4	6.78	10.7
SM 1219-9	3	97	30	2.4	22.5	23	0.51	31.2	6.65	7.6
CM 8027-3	7	123	31	2.9	21.6	21	0.52	31.9	6.61	7.5
CM 6070-1	1	18	2	2.5	19.9	21.7	0.48	32.5	6.20	5.7
SM 2192-6	2	14	5	2.7	19.6	22	0.47	33.4	6.19	8.0
SM 1565-17	8	178	21	2.8	20.8	21	0.51	30.6	6.05	1.8
SM 1433-4	4	60	15	2.4	19.5	24	0.45	32.1	6.04	3.1
SM 1438-2	3	65	8	2.8	19.2	20	0.50	32.7	6.01	5.2
CM 7514-8	5	97	15	2.8	18.8	20	0.49	33.0	5.96	5.6
CM 7985-24	5	167	26	2.6	19.8	24	0.45	30.8	5.86	-1.7
SM 805-15	6	133	29	2.9	18.6	21	0.48	32.2	5.72	1.4
CM 6754-8	7	148	17	2.7	19.2	19	0.51	31.0	5.65	1.0
MTAI 8	7	130	12	2.6	19.6	22	0.48	30.2	5.61	-1.5
SM 1789-20	4	88	10	2.4	19.2	25	0.43	30.3	5.46	-4.1
SM 1657-12	2	9	1	2.7	17.7	20	0.47	31.2	5.35	-1.6
CM 4843-1	7	131	17	3.0	17.5	21	0.48	31.2	5.33	-3.5
CM 3555-6	3	33	1	2.4	17.3	22	0.45	31.2	5.16	-3.0
SM 643-17	3	48	5	2.8	16.5	19	0.46	32.5	5.13	-1.2
CM 2772-3	10	204	1	2.3	18.9	22	0.47	27.7	4.96	-10.1
CM 6758-1	5	140	7	2.7	16.5	21	0.45	30.6	4.79	-7.2

FRY=Fresh root yield; **FFY**= Fresh Foliage yield; **HI**= Harvest Index; **DMC**= Dry matter content; **DMY**=Dry matter yield; **Sel.Ind.**= Selection Index.

The parental clones listed in Table 4.4 have been ordered based on the proportion of clones selected. Clone SM 1665-2 was used in two families, which combined included 55 clones, 28 of them were selected (51%). Clone SM 1411-5 participated as progenitor in seven families, generating a total of 138 clones of which 53 were selected (38%). On the other hand, at the bottom of Table 4.4 it is clone CM 6758-1. It was one of the progenitors in five families and was represented by a total of 140 clones of which only 7 were selected (5%). The relevance of this information should be obvious to the reader. Furthermore information from Table 4.4 points out the strengths and weaknesses of each progenitor, as reflected in the average performance of their progenies. For instance the progenies from clone SM 1665-2 (Top of the table) showed the highest average fresh root yield (25.5 t/ha) and harvest index (0.61), but tended to have low dry matter content (30.7%). The second best progenitor, on the other hand, produced progenies with a much better average dry matter content (32.4%), but with lower fresh root yield (21.9 t/ha) and harvest index (0.51). The progenies from clones located at the bottom of Table 4.4 tended to have lower average for fresh root yields, harvest index, and/or dry matter content. Clone CM 2772-3 is adapted to the acid soils savannas environment and the Putumayo Department, it was included as progenitor in this trial because it has yellow roots.

As explained in Output 3 (Figure 3.1) the following step in the selection process is the **Preliminary Yield Trial or PYT**. Clones evaluated in these trials are those selected during the *CET* conducted the previous year. The seven plants from the *CET* produce more than 30 stakes. Therefore, the *PYT* are planted with three replications of 10-plant plots. Each experimental plot consists of two rows with five plants each. Since selections at the *CET* stage are conducted in there different blocks selections within each block generate a respective *PYT*. The clones allocated to each block at the *CET* (and selected) are therefore, competing among themselves also at the *PYT* phase. The reasons for this are: a) This approach maximized the genetic variability within each *PYT* by maximizing the number of families present in it; b) The performance of the cassava plant depends heavily on the quality of the stake from which it grew, and the quality of the stakes, in turn, depends on the environmental conditions in which the mother plant grew. By keeping together in the same *PYT* trial the clones that grew together at the *CET* a better uniformity of the quality of the stakes is achieved and, therefore, the experimental error at the *PYT* is somewhat reduced.

The *CET* trial conducted in June 2002-May 2003 failed to provide uniform plant densities and therefore it was not used for selection purposes but as a multiplication nursery. The evaluation and selection trials were then conducted during the June 2003 – May 2004 season. Because of this reason *PYT*s 1 to 3 include clones that were selected during the *CET* harvested in 2002. *PYT*s 4 to 6 include clones that were selected during the *CET* harvested in May 2003.

Tables 4.5 to 4.7 provide the most relevant information for *PYT*s 1, 2 and 3 from the *CET* harvested in May 2002. Tables 4.8 to 4.10 provide similar information for *PYT*s 4, 5 and 6 from the *CET* harvested in May 2003. The trials from the 2002 *CET* had average dry matter yields of 8.8; 8.7; and 9.2 t/ha respectively for *PYT*1, *PYT*2 and *PYT*3. It seems that the environmental conditions for *PYT*3 were better for those in *PYT*1 and *PYT*2. The average dry matter yield in the selected group of 20 clones from each trial was 12.7; 11.6; and 13.2 t/ha, respectively for *PYT*1, *PYT*2 and *PYT*3.

Table 4.5. Relevant results from the **Preliminary Yield Trial-1** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 1 harvested in May 2002. Individual performances of the best eight clones are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
GM 290-14	1.7	45.2	26.6	0.63	31.0	14.1	27.49
CM 9957-76	2.0	44.4	26.0	0.63	30.4	13.5	23.13
CM 9926-49	1.7	41.5	15.4	0.73	27.6	11.5	22.99
GM 290-65	2.3	47.2	33.9	0.58	31.3	14.7	22.08
GM 290-18	1.3	42.2	19.8	0.68	27.7	11.8	21.58
CM 9957-70	1.0	36.2	26.3	0.58	31.0	11.2	17.81
CM 9958-44	3.0	52.3	38.3	0.58	29.3	15.2	17.31
CM 9957-47	1.3	38.5	20.1	0.66	27.8	10.7	16.44
Parameters of the 20 clones selected							
Maximum	3.0	52.3	38.3	0.73	31.3	15.2	27.49
Minimum	1.0	36.0	15.4	0.58	27.6	10.7	15.29
Average	2.0	42.8	25.4	0.63	29.8	12.7	20.05
St. Deviation	0.7	5.1	6.9	0.05	1.6	1.6	3.96
Parameters of the 81 clones evaluated							
Maximum	5.0	52.3	45.1	0.74	34.0	15.2	27.49
Minimum	1.0	1.3	0.5	0.45	20.1	0.3	-38.05
Average	2.6	30.3	21.7	0.59	29.0	8.8	0.00
St. Deviation	1.0	10.9	9.2	0.06	2.9	3.2	14.00

Table 4.6. Relevant results from the **Preliminary Yield Trial-2** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 2 harvested in May 2002. Individual performances of the best eight clones are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
GM 213-56	1.3	54.7	30.7	0.64	27.5	15.1	29.48
GM 213-2	2.0	29.1	29.9	0.49	37.4	10.9	24.94
CM 9958-80	1.7	33.7	17.9	0.65	31.7	10.7	23.42
GM 214-62	3.0	37.4	23.9	0.61	33.3	12.4	21.75
GM 302-25	1.0	40.8	32.6	0.55	30.1	12.2	20.07
CM 9966-57	2.7	42.3	23.1	0.65	30.0	12.7	19.63
GM 214-60	2.3	32.0	22.6	0.59	33.2	10.6	18.13
GM 236-62	3.3	29.9	19.7	0.61	34.8	10.4	17.59
Parameters of the 20 clones selected							
Maximum	3.3	54.7	32.6	0.65	37.4	15.1	29.48
Minimum	1.0	25.6	17.9	0.49	27.5	8.8	15.98
Average	2.1	36.4	25.1	0.59	32.3	11.6	20.79
St. Deviation	0.7	8.4	4.9	0.05	2.9	1.7	4.19
Parameters of the 64 clones evaluated							
Maximum	4.7	54.7	43.3	0.70	37.4	15.1	29.48
Minimum	1.0	4.6	3.3	0.39	24.8	1.3	-38.26
Average	2.7	28.5	23.8	0.55	30.6	8.7	0.00
St. Deviation	0.9	10.4	9.4	0.06	2.2	3.2	15.66

Table 4.7. Relevant results from the **Preliminary Yield Trial-3** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 3 harvested in May 2002. Individual performances of the best eight clones are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
GM 273-57	2.7	49.9	30.7	0.62	32.3	16.1	30.34
GM 290-50	1.7	37.2	20.5	0.66	33.6	12.5	29.93
GM 262-54	1.7	53.5	41.8	0.56	29.8	15.9	27.01
GM 259-63	1.3	35.9	17.5	0.67	32.2	11.5	26.34
GM 262-57	1.7	49.2	33.8	0.59	29.3	14.4	23.41
GM 274-14	2.0	39.5	22.3	0.64	31.4	12.4	22.26
GM 274-14	2.0	36.5	28.2	0.56	33.9	12.3	20.99
CM 9957-75	2.7	48.7	37.4	0.57	30.1	14.6	18.43
Parameters of the 20 clones selected							
Maximum	2.7	53.5	41.8	0.67	33.9	16.1	30.34
Minimum	1.0	35.3	17.5	0.55	29.3	10.7	17.54
Average	1.8	42.2	28.3	0.60	31.4	13.2	23.42
St. Deviation	0.6	7.2	7.9	0.04	1.6	1.9	4.82
Parameters of the 72 clones evaluated							
Maximum	5.0	53.5	41.8	0.67	33.9	16.1	30.34
Minimum	1.0	8.4	7.2	0.31	20.9	2.7	-35.67
Average	2.6	30.8	24.8	0.56	30.0	9.2	0.00
St. Deviation	1.0	9.9	8.7	0.07	2.5	3.0	15.28

Table 4.8. Relevant results from the **Preliminary Yield Trial-4** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 1 harvested in May 2003. Individual performances of the best eight clones are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
SM 2834-2	2.0	45.3	29.8	0.60	33.1	14.9	37.74
SM 2620-67	3.0	53.9	34.5	0.61	27.6	14.9	31.24
GM 281-79	2.3	57.4	25.7	0.69	22.4	12.8	28.89
SM 2620-62	2.3	37.1	19.3	0.66	28.4	10.5	18.58
SM 2779-38	1.3	32.8	20.5	0.62	30.4	9.9	18.58
CM 9912-15	1.3	37.9	28.4	0.57	28.9	11.0	18.25
CM 9912-13	1.3	31.7	27.7	0.53	32.7	10.3	17.74
SM 2779-49	1.3	26.8	23.4	0.53	34.2	9.2	16.48
Parameters of the 25 clones selected							
Maximum	3.0	57.4	34.5	0.69	34.2	14.9	37.74
Minimum	1.3	26.8	19.3	0.53	22.4	9.2	14.53
Average	2.0	38.8	25.8	0.59	30.0	11.4	21.84
St. Deviation	0.7	10.2	4.6	0.05	3.4	2.1	7.85
Parameters of the 110 clones evaluated							
Maximum	5.0	57.4	58.4	0.71	34.2	14.9	37.74
Minimum	1.0	6.8	5.9	0.30	20.4	2.1	-29.14
Average	2.8	27.8	24.8	0.54	28.8	8.0	0.00
St. Deviation	1.1	8.5	9.8	0.08	3.1	2.4	13.00

Table 4.9. Relevant results from the **Preliminary Yield Trial-5** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 2 harvested in May 2003. Individual performances of the best eight clones are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
SM 2779-56	2.7	50.8	29.0	0.64	30.3	15.3	36.73
SM 2828-28	2.7	31.0	19.4	0.61	34.0	10.6	24.27
SM 2952-33	2.0	41.0	31.2	0.57	29.5	12.1	21.99
SM 2947-21	2.3	43.3	38.4	0.53	29.2	12.7	20.16
SM 2964-31	3.3	46.9	28.1	0.63	26.6	12.5	19.30
SM 2839-16	2.0	36.4	34.0	0.52	31.2	11.3	18.60
SM 2834-28	3.3	45.1	46.9	0.49	29.5	13.3	16.84
CT 54-19	2.3	28.7	16.0	0.64	30.9	8.9	16.67
Parameters of the 25 clones selected							
Maximum	3.3	50.8	46.9	0.64	34.0	15.3	36.73
Minimum	2.0	28.2	16.0	0.49	26.6	8.9	14.66
Average	2.5	38.7	30.0	0.57	30.4	11.7	20.43
St. Deviation	0.5	7.9	9.6	0.06	2.0	2.0	6.47
Parameters of the 110 clones evaluated							
Maximum	5.0	50.8	60.9	0.71	34.3	15.3	36.73
Minimum	1.0	5.8	4.6	0.34	18.1	1.6	-44.21
Average	2.5	27.8	25.9	0.53	28.0	7.9	0.00
St. Deviation	0.9	9.5	11.8	0.08	2.9	2.9	15.00

Table 4.10. Relevant results from the **Preliminary Yield Trial-6** planted in Santo Tomás (Dto Atlántico) derived from the CET-Block 3 harvested in May 2003. Individual performances of the best eight clones are presented..

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
SM 3000-30	3.0	48.5	36.5	0.57	29.8	14.4	32.69
SM 2964-48	2.3	42.3	41.0	0.51	33.5	14.2	30.98
SM 2629-92	1.0	37.5	25.8	0.59	30.3	11.4	30.36
CT 59-51	3.3	40.6	26.5	0.61	31.7	12.9	30.18
SM 2834-41	2.3	31.1	23.6	0.57	34.6	10.8	26.46
SM 2779-82	3.0	40.9	26.9	0.60	29.1	11.8	26.21
SM 2956-22	1.7	21.9	10.3	0.67	32.1	7.0	21.83
CM 9912-54	3.3	34.8	28.5	0.55	31.7	10.9	20.12
Parameters of the 25 clones selected							
Maximum	3.3	48.5	41.0	0.67	34.6	14.4	32.69
Minimum	1.0	21.9	10.3	0.51	27.1	7.0	19.57
Average	2.5	36.6	27.1	0.59	31.0	11.3	25.84
St. Deviation	0.8	8.4	10.3	0.06	2.2	2.5	5.11
Parameters of the 110 clones evaluated							
Maximum	5.7	48.5	55.9	0.69	34.6	14.4	36.54
Minimum	1.0	3.6	1.7	0.36	16.6	0.7	-41.39
Average	3.0	20.8	15.7	0.58	26.6	5.7	0.00
St. Deviation	1.0	10.2	9.4	0.07	4.4	3.2	15.97

The trials from the 2003 CET had average dry matter yields of 8.0; 7.9; and 5.7 t/ha respectively for *PYT4*, *PYT5* and *PYT6*. It seems that the environmental conditions for *PYT6* were in this case much worse than those for *PYT1* and *PYT2*. The average dry matter yield in the selected group of 20 clones from each trial was 11.4; 11.7; and 11.3 t/ha, respectively for *PYT4*, *PYT5* and *PYT6*.

An interesting feature from the *PYT*s described in Tables 4.5 to 4.7 is the frequency of clones from a given family selected. Families CM 9957 and GM 290 had 7 of their clones selected (across the three *PYT* experiments). Family CM 9958 had four clones selected and families GM 274, GM 262 and CM 9966 had three.

During the June 2001-May 2002 season a Diallel Study was conducted. That trial was used for generating valuable quantitative genetics information regarding the inheritance of the most relevant traits in cassava. The trial was also used for selection purposes and the best clones from that experiment were included in a *CET* during the June 2002 – May 2003 and the selected clones were grouped for a *PYT* whose results are presented in Table 4.11. It is worth to mention, for example the outstanding performance of family GM 258, which had three of its clones selected from *PYT-7* (Table 11). Families CM 9954 and GM 246 had two of their clones selected.

Table 4.11. Relevant results from the **Preliminary Yield Trial-7** planted in Santo Tomás (Dto Atlántico) involving the best germplasm in the Diallel Study harvested in May 2002. The trial included 60 genotypes, evaluated in three replications with 10-plant plots. Individual performances of the 12 clones selected are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	Selection index
GM 258-3	1.0	43.1	25.4	0.63	29.92	12.87	34.06
GM 280-15	1.7	39.1	25.6	0.60	31.00	12.21	28.31
GM 236-26	3.0	46.6	33.3	0.59	31.15	14.52	26.53
GM 272-20	3.0	46.2	37.9	0.55	30.65	14.16	22.40
GM 291-26	3.0	41.4	31.9	0.57	30.85	12.84	20.33
CM 9954-16	2.3	44.1	39.5	0.52	29.31	12.90	19.09
GM 246-6	2.0	40.3	22.4	0.64	25.94	10.48	18.73
GM 258-2	2.5	18.6	12.4	0.60	34.65	6.42	16.02
GM 247-15	2.7	44.6	34.8	0.56	26.48	11.96	13.79
GM 258-24	1.0	27.6	16.8	0.63	25.91	7.10	12.81
GM 246-15	2.3	28.9	20.1	0.58	28.81	8.54	9.96
CM 9954-23	3.0	12.9	8.6	0.60	34.83	4.49	9.87
Parameters of the 12 clones selected							
Maximum	3.0	46.6	39.5	0.64	34.83	14.52	34.06
Minimum	1.0	12.9	8.6	0.52	25.91	4.49	9.87
Average	2.3	36.1	25.7	0.59	29.96	10.71	19.32
St. Deviation	0.7	11.4	10.1	0.04	2.95	3.29	7.52
Parameters of the 60 clones evaluated							
Maximum	5.0	46.6	45.9	0.73	34.83	14.52	34.06
Minimum	1.0	3.9	2.2	0.42	18.96	1.11	-29.62
Average	2.9	24.2	18.9	0.58	27.36	6.70	0.00
St. Deviation	1.0	12.9	11.9	0.07	3.49	3.76	14.26

Clones selected at the *PYT*s are then grouped together in an **Advanced Yield Trial** or **AYT**, which are then planted in more than one location and in 20-plant plots. During the June 2003 – May 2004 season the *AYT* was planted in three locations and the most relevant results (combined across the three locations) are presented in Table 4.12.

The first thing to point out about this trial is the outstanding performance of the materials with an average dry matter yield close to 14 t/ha. Four clones (SM 2772-5; SM 2773-21; SM 2615-25; and SM 2621-21) had higher dry matter yields than the best check (MATI 8 which yielded 16.7 t/ha of dry matter).

Table 4.12. Across location averages from the **Advanced Yield Trial** planted in three sites in the Atlantico Department (Santo Tomás, La Ester and Palapa). The trial included 35 genotypes, evaluated in three replications with 20-plant plots. Individual performances of the 10 best clones (based on dry matter yield) are presented.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	HCN (1-9)
SM 2772-5	1.9	59.3	34.1	0.64	30.0	17.4	5.0
SM 2773-21	2.3	51.7	38.1	0.57	33.3	17.0	9.0
SM 2615-25	3.1	49.1	40.0	0.54	34.3	16.9	8.3
SM 2621-21	1.9	50.3	26.7	0.64	33.0	16.8	8.7
SM 2781-6	1.9	46.8	35.3	0.57	35.8	16.7	9.0
SM 2782-4	2.4	52.7	34.7	0.60	31.1	16.2	5.3
SM 2619-4	3.0	48.9	37.2	0.57	32.5	15.7	6.7
SM 2546-32	2.2	46.0	20.0	0.69	33.1	15.2	6.0
SM 2626-7	1.6	45.9	24.5	0.65	33.0	15.1	8.0
SM 2783-26	1.8	45.4	35.1	0.56	31.1	14.0	5.3
Parameters of the 4 checks							
M TAI-8	4.1	48.3	39.6	0.55	34.8	16.7	4.3
CG 1141-1	3.2	42.7	35.2	0.54	33.7	14.3	9.0
CM 3306-4	2.4	43.6	31.0	0.59	32.1	13.9	9.0
SM 1438-2	2.1	37.2	28.2	0.58	34.8	12.9	5.0
Parameters of the 35 clones evaluated (including the four checks)							
Maximum	4.6	65.2	51.2	0.7	37.4	20.9	9.0
Minimum	1.0	25.6	18.8	0.4	27.3	8.5	3.3
Average	2.4	42.4	32.7	0.6	33.0	13.8	6.5
St. Deviation	0.8	8.6	7.7	0.1	2.4	2.8	1.7

The last step in the evaluation and selection cycle (Figure 3.1) is the *Regional Trial (RT)*. Because of adverse environmental conditions during the previous years not enough planting material for the *RT* of the current season to be planted in only two locations. Only one of them has been already harvested and the results from this *RT* are presented in Table 4.13. The best check was CM 4843-1 with an average dry matter yield of 13.7 t/ha. This clone has been recently released by CORPOICA with the name of CORPOICA-Ginés. Only one experimental clone (SM 1427-1), showed a higher dry matter yield (13.8 t/ha). The second best check was CM 4919-1 also released this year with the name “CORPOICA-Verónica”

which yielded an average of 11.0 t/ha of dry root yield. Three experimental clones (SM 1521-10, SM 1759-29 and SM 1511-6) presented dry matter yield between those of the best two checks (ranging from 11.1 to 11.8 t/ha). Immediately below clone CM 4919-1 were MTAI 8 checks that had also been released this year and CM 3306-19 released in 2000 (CORPOICA-Colombiana).

Table 4.13. Across location averages from the **Regional Trial** planted in La Ester (Atlántico Department). The trial included 30 genotypes, evaluated in three replications with 25-plant plots. Individual performances of the 15 best clones (based on dry matter yield) are presented. Clones are ranked with those with highest selection index on top. Highlighted in bold-italic font are the five checks included in the experiment.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)	HCN (1-9)
SM 1427-1	3.0	37.8	32.8	0.54	36.6	13.8	6.3
<i>CM 4843-1</i>	<i>4.0</i>	<i>38.3</i>	<i>28.3</i>	<i>0.58</i>	<i>35.7</i>	<i>13.7</i>	<i>8.0</i>
SM 1521-10	2.3	35.7	19.7	0.65	33.2	11.8	4.7
SM 1759-29	2.0	32.0	37.1	0.46	36.0	11.4	3.7
SM 1511-6	1.7	29.9	23.3	0.57	37.3	11.1	4.7
<i>CM 4919-1</i>	<i>1.7</i>	<i>30.5</i>	<i>18.3</i>	<i>0.62</i>	<i>35.8</i>	<i>11.0</i>	<i>9.0</i>
<i>M TAI 8</i>	<i>1.7</i>	<i>31.6</i>	<i>20.6</i>	<i>0.61</i>	<i>33.9</i>	<i>10.8</i>	<i>8.7</i>
<i>CM 3306-19</i>	<i>2.0</i>	<i>30.4</i>	<i>13.6</i>	<i>0.69</i>	<i>33.2</i>	<i>10.1</i>	<i>7.0</i>
<i>M VEN 25</i>	<i>1.7</i>	<i>29.0</i>	<i>28.6</i>	<i>0.50</i>	<i>34.3</i>	<i>10.0</i>	<i>9.0</i>
SM 1433-4	2.3	28.6	26.6	0.52	34.9	10.0	4.3
SM 2081-34	2.0	28.0	27.7	0.51	35.3	9.9	7.0
CM 9067-2	2.3	26.8	21.9	0.55	35.6	9.5	8.3
SM 1411-5	1.0	26.7	24.4	0.53	35.1	9.3	8.3
CM 6119-5	2.0	25.2	21.7	0.53	35.8	9.0	5.7
SM 1669-7	2.3	24.4	22.9	0.51	36.7	9.0	5.3
Parameters of the 35 clones evaluated (including the five checks)							
Maximum	4.0	38.3	46.9	0.69	37.3	13.8	9.0
Minimum	1.0	19.5	13.6	0.37	31.3	6.9	3.7
Average	2.3	27.2	26.4	0.52	35.0	9.5	6.3
St. Deviation	0.6	5.1	6.6	0.07	1.3	1.8	1.7

In a very large experiment evaluating *RT* in 11 different locations the Eberhardt and Russell stability analysis suggested that the two clones evaluated and selected by farmers in a farmer's participatory breeding project showed the highest regression coefficients. That suggested that these clones were particularly well adapted to the better growing conditions, which was a surprise. In general selections conducted in the more limiting conditions and cultural practices of farmers was expected to select for genotypes particularly adapted to harsh environmental conditions. These results prompted a second one in which only eight genotypes were grown. These trials will be conducted at several locations and for two consecutive years. Table 4.14 shows the results of the combined analysis across the three locations in the Atlántico Department where these trials were planted.

Table 4.14. Evaluation of eight clones in a special study to compare performances of clones released by traditional and farmers' participatory approaches. Eight clones were evaluated in three locations in the Atlantico Department. Trials were based on three replications with 25-plant plots.

Clon	Plant type (1-5)	Fresh root yield (t/ha)	Fresh foliage yield (t/ha)	Harvest Index (0-1)	Dry matter content (%)	Dry matter yield (t/ha)
SM 1565-17	3.22	46.33	24.20	0.65	27.88	12.98
CM 4843-1	5.00	39.68	28.04	0.58	30.54	12.19
CM 4919-1	1.11	34.90	20.42	0.62	32.14	11.31
CM 3555-6	2.78	36.77	33.26	0.51	30.22	11.13
SM 1411-5	2.67	33.15	29.38	0.53	32.13	10.67
CM 3306-19	3.44	32.57	26.48	0.55	29.83	9.79
SGB 765-2	3.22	30.12	28.15	0.50	31.48	9.68
SGB 765-4	4.78	25.65	34.22	0.41	33.20	8.44

The two clones developed through a participatory approach (SGB 765-2 and SGB 765-4) showed the two lowest dry matter yields (around 9 t/ha) compared with the remaining six clones, which averaged 11.35 t/ha with a maximum of 12.98 t/ha (SM 1565-7) and a minimum of 9.79 t/ha (CM 3306-19).