EVALUATION OF CASSAVA AND BEAN GERMPLASM IN EAST TIMOR

Reinhardt H. Howeler[1], Brian Palmer[2] and Koes Hartojo[3]

ABSTRACT

Cassava (*Manihot esculenta* Crantz) is the third most important food crop in East Timor, after maize and rice. It is mostly planted in backyards or in small plots near the house. Plants are pulled up when needed and the peeled roots are eaten after boiling. Most local varieties have good eating quality but low yields and starch contents. The average cassava yield in the country is reported as 4 t/ha, one of the lowest in Asia. Two introductions of cassava varieties, mostly from East Java, Indonesia, were tested in 2000/01 and 2001/02, respectively. Data from one trial indicate that high yields of up to 35 t/ha could be obtained with promising breeding lines developed by RILET in Malang, compared with yields of about 14 t/ha for two local varieties. Similar trials conducted in 2002, indicate the superior growth of some other breeding lines from RILET, which seem to have exceptional tolerance to low soil Zn and Fe. Yields up to 25 and 38 t/ha were obtained in Baucau and Aileu, respectively, compared with 10-15 t/ha for the local varieties.

Beans (*Phaseolus vulgaris*) germplasm from Africa as well as Latin America have also been evaluated, but no data are yet available.

Several varieties of other pulses, including mungbean (*Vigna radiata*) soybean (*Glycine max*) and cowpea (*Vigna unguiculata*), were also introduced from Indonesia, Thailand and Australia. In general, the Indonesian varieties seem to be best adapted to the soil and climatic conditions of East Timor. The mungbean varieties Murai, Merpati, Perkutut and Kenari all outyielded the local mungbean variety; the soybean variety Kawi had consistently the highest yield among the tested soybean varieties, while the cowpea variety KT-5 was superior to KT-9 and the local varieties Hitam and Merah.

INTRODUCTION

After the vote for independence of East Timor in Aug 1999, a large part of the population was displaced to West Timor or fled into the mountains. This massive disruption of normal agricultural activities resulted in the loss of seed of local varieties. Although large amounts of seed were imported from other countries in time for the 2000 planting season, much of this seed was of poor quality and/or the varieties were not well adapted to the local soil and climatic conditions. In order to improve food production and reduce poverty, ACIAR of Australia requested the collaboration of five Future Harvest Centers in Asia to help introduce and evaluate promising germplasm of rice, maize, cassava, potato, sweet potato, peanut, beans and other pulses. This paper describes the evaluation of cassava, beans and other pulse crops during the first two years of the project, i.e. 2000/01 and 2001/02.

CASSAVA AND BEAN PRODUCTION

Both in terms of production and area, cassava (*Manihot esculenta* Crantz) is the third most important crop in East Timor, after maize and rice (**Table 1**). Cassava is used mainly for direct human consumption, i.e. after boiling of the peeled roots with little or no prior processing. For that reason, most of the local varieties are "sweet" with a low cyanogenic potential. Some cassava, however, may also be used for on-farm pig feeding,

---

[1] CIAT Cassava Office for Asia, Dept. of Agriculture, Chatuchak, Bangkok 10900, Thailand
[2] Seeds of Life-East Timor Project, P.O. Box 221, Dili, East Timor
[3] Research Institute for Legumes and Tuber Crops (RILET), P.O.Box 66, Malang, E. Java, Indonesia

but the extent of this is not known. There is no processing of cassava roots into starch or other industrial products.

Table 1. East Timor: Agricultural Production, 1997.

Food Crops	Production (tonne)	Yield (t/ha)	Estimated area[1)] (ha)
Food Crops			
Maize	106,600	1.8	59,222
Rice	52,000	2.7	19,259
Cassava	66,500	4.0	16,625
Sweetpotato	16,200	3.9	4,154
Peanut	3,200	1.0	3,200
Soybean	1,200	0.8	1,500
Tree crops			
Coconut	9,900	0.2	49,500
Coffee	9,700	0.2	48,500
Candlenut	690	0.2	3,450
Cocoa	42	0.08	525
Cloves	12	0.05	240

Source: *Central Bureau of Statistics, 1998*

[1)] Calculated from total production and yield

Table 2 shows the names and principal characteristics of the local cassava varieties. Many of these are likely to be the same variety but with different local names. Most of these probably originated in Indonesia, but some may have been introduced by the Portuguese directly from Brazil.

Table 2. Names and characteristics of some local cassava varieties in East Timor.

	Characteristics	
Name[1)] (meaning)	Top	Roots
1. Mentega (butter)	Red petioles, yellowish stem, dark green leaves and brownish shoot, branched	Brown skin, yellowish parenchyma
2. Nona Metam[2)] (black girl)	Red petioles, big light-green leaves, less branched	Red skin, white parenchyma
3. Ermera[2)]	Dark red-purple petioles, greenish-brown stem, green leaves and shoot	Red skin, white parenchyma
4. Putih (white)	Green petioles, light-green leaves, low branching	White skin, white parenchyma
5. Manu Tolu (yellow egg)		
6. Lesu (white)		
7. Autohan (han=eat)		

[1)] Some of these may be the same varieties with different local names.

[2)] Ermera and Nona Metam look very much like the Thai variety Hanatee.

While the local cassava varieties have been selected mainly for excellent eating quality, these tend to have a low yield potential and relatively low dry matter (DM) content.

In the future it is expected that cassava will be grown not only for human consumption, but also for animal feeding and possibly for starch extraction. For this, varieties with higher yield and higher DM or starch content are required.

Cassava as a species is particularly well adapted to dry climates or to areas with unpredictable rainfall. Once established, cassava tolerates long (6-8 months) periods of drought. During the drought the plants may drop many leaves and new leaf production is limited, but once it starts raining again the plant can quickly mobilize the carbohydrates stored in the roots to re-establish a full leaf canopy and continue growth. Cassava as a species is very well adapted to acid soils, but not well adapted to high pH or saline soils. At high pH (above 7.5), especially in the presence of Ca- or Mg-carbonates, cassava often suffers from micronutrient deficiencies, particularly Zn and Fe, and occasionally Mn. However, varieties differ very markedly in their ability to take up Zn or Fe from soils that are very low is these nutrients, and varietal selection for tolerance to Fe and Zn deficiency is probably a more practical solution to this problem than micronutrient applications.

Like cassava, beans (*Phaseolus vulgaris*) originated in Latin America, and most of the genetic variability exists in that continent. Unlike in Latin America, beans are not a staple food anywhere in Asia, but are consumed mainly as a snack food or dessert. However, in East Timor beans are consumed as a staple food, and they constitute an important source of protein in the diet. This is probably due to the Portuguese, who brought beans from Brazil for that purpose.

While in Latin America beans are generally grown, traded and consumed as a single variety, with a characteristic size, shape and color of the grain, in East Timor (and much of Africa), beans are generally sold on the market as varietal mixtures, with many different shapes and colors. It is likely that they are also planted as varietal mixtures, partially to reduce the incidence of pests and diseases. In Latin America, beans suffer from a host of insects and disease problems, but it is not known yet which of these are of importance in East Timor. Beans are particularly well adapted to cooler climates, i.e. elevations of 800 to 2000 masl in the tropics. They require adequate soil moisture during establishment, vegetative growth and flowering, but prefer dryer weather during pod set and ripening.

Beans are not well adapted to very acid soils and may suffer from Al-toxicity when the percent Al-saturation is above 20%. Beans also require fairly high levels of available P in the soil, but some varieties are quite tolerant of low-P.

Other grain legumes (also known as "pulses"), such as mungbean (*Vigna radiata*), cowpea (*Vigna unguiculata*) and soybean (*Glycine max*) are grown in East Timor mainly in home gardens or in small plots. The total area is probably less than 3000 ha. These three grain legumes are generally used for human consumption or for animal feeding (soybean). They are an important source of protein in the diet. While cowpea is well-adapted to acid soils, both mungbean and soybean do not tolerate high levels of exchangeable Al and prefer rather fertile soils with a near neutral pH. All three legumes grow well at low elevation, while growth and production is reduced at lower temperatures found at higher elevation, such as above 800 masl.

GERMPLASM EVALUATION

Most of the germplasm evaluation trials for the upland crops were conducted in Baucau and Los Palos in the east, Aileu and Maubisse in the central highlands, Betano along the south coast, and in Loes or Maliana in the western part of the country.

Table 3 shows results of soil analyses of samples taken between Nov 2000 and March 2002 in four districts of East Timor, mainly from these experimental sites. According to these results, soils have a pH ranging from 4.9 to 7.5, i.e. most soils are slightly acid to slightly alkaline. Most are relatively high in OM, very high in Ca, Mg and K and quite high in P except for a few sites in Aileu district. P deficiency could be a limiting factor for maize and pulses in the Aileu and Baucau sites. Neither high Al or high Na seem to be a problem. The main problem, at least for cassava, is the extremely low levels of Zn and Fe at the Betano (Manuhafi) and Don Bosco (Baucau) sites, and possibly the low levels of Cu and Mn at the Betano site. Other crops, especially peanut, are likely to be affected by Fe deficiency in these two sites.

1. Cassava

In late 2000, vegetative planting material (stems) of twelve cassava varieties were introduced to East Timor, ten from Indonesia and two eating varieties from Thailand. These were planted in replicated trials in Baucau, Los Palos, Maubisse and Maliana. Each variety was planted in plots of 5 x 5 m with nine plants of the test variety in the center, and borders of a local variety. Plants were spaced at 1.0 x 1.0 m. There were generally three replications per trial. In some trials 200 kg/ha of 15-15-15 fertilizers were applied shortly after planting.

Due to various circumstances, no reliable data could be obtained in three of the four sites. **Table 4** shows the results of the cassava trial at the Maliana site in Bobonaro district. Root yields varied from 6.9 to 35.4 t/ha, with a yield of 13.5 and 14.9 t/ha for the two local varieties Mentega and Nona Metan. Highest yields were obtained with the Indonesian breeding lines OMM90-3-100, SM477-2 and the released variety Malang 2. Most of the local eating varieties from Indonesia and Thailand had low yields of 10-20 t/ha. Planting material of the harvested plants was not properly marked and stored, and could thus not be used for further experimentation.

In January 2002 new planting material was brought in from Indonesia, mainly breeding lines from the Research Institute for Legumes and Tuber Crops (RILET) in Malang, East Java. This material was used to plant replicated trials in four sites, i.e. Baucau, Betano, Aileu and Loes. These were planted in Jan-Feb 2002 and were harvested in Dec 2002 and January 2003.

During a brief visit in March 2002, we saw the cassava trials in Baucau, Aileu and Betano. Plants were 2-2½ months old. In Baucau, on calcareous soils, many cassava varieties showed clear symptom of Zn and possibly Fe deficiency, while in some plots many stakes had either not germinated or plants had died shortly after germination, most likely as a result of severe Zn deficiency. Other varieties, however, particularly CMM95-42-3, CMM96-36-269 and OMM96-01-69, were growing very well. Obviously, there were large varietal differences in tolerance to low-Zn.

Table 3. Chemical and physical characteristics[1)] of some soils in East Timor in 2000, 2001 and 2002.

Sample no.		Sample location and description	Date	Lab series
Baucau	-1	Don Bosco Technical School in Fatomaca; field of dark brown limestone derived soil	Nov 00	S-33
	-2	Baucau experimental site at Fatomaca; red clay soil	Jan 02	S-107
Ainaro	-1	Near Maubisse; 80% slope, purple brown clay soil after burning	Nov 00	S-33
	-2	South of Maubisse; at 1,300 masl, yellow clay with lime stones	Nov 00	S-33
	-3	South of Maubisse; same site, lower field, brown-red clay soil	Nov 00	S-33
	-4	Maubisse, Coffee Cooperative; Bobonaro clay	Oct 01	S-137
Aileu	-1	Aileu experimental site; dark purple soil	Jan 02	S-107
	-2	Aileu experimental site; in cassava trial	Mar 02	S-107
Manufahi	-1	Betano Extension Station; grey clay with rocks	Oct 01	S-137
	-2	Betano Experimental site; in cassava trial, yellow cassava	Mar 02	S-107
Liquisa	-1	Loes Transmigration Office; field behind office, silty loam	Oct 01	S-137
	-2	Loes Transmigration Office; rice fields; grey loam	Oct 01	S-137

		<---Chemical characteristics															--->	<-----Physical characteristics			---->
			%	ppm	<-------------me/100 g			------------->		%	%	mmh/cm	<---ppm				--->	<------------%		----------->	
Sample no.		pH	OM	P	Al	Ca	Mg	K	Na	Al	Na	E.C.	B	Zn	Mn	Cu	Fe	Sand	Silt	Clay	Texture[2)]
Baucau	-1	5.6	3.3	6.2	0	15.41	0.98	0.28		0			0.48	0.32	209.7	0.24	0.6	20.0	25.0	55.0	clay
	-2	5.7	3.7	7.9	0	11.78	0.87	0.19	0.06	0	0.5	0.35	0.90	0.45	208.0	0.22	0.8	15.6	18.3	65.1	clay
Ainaro	-1	6.5	6.0	28.5	0	15.39	3.20	0.84		0			2.00	2.75	140.2	1.01	4.4	-	-	-	-
	-2	6.6	3.1	2.4	0	16.17	5.40	0.51		0			0.56	1.78	95.0	1.31	8.8	21.0	36.4	42.6	clay
	-3	6.6	3.3	2.3	0	16.18	5.51	0.47		0			0.56	1.87	126.7	1.57	15.2	26.3	33.7	40.0	c.l.
	-4	7.2	3.1	8.6	0	26.80	6.11	0.54	0.39	0	1.1	0.57	0.60	0.89	142.8	0.07	15.1	19.8	29.9	50.3	clay
Aileu	-1	4.9	5.0	5.3	0.94	3.20	1.35	0.49		16		0.44	0.90	1.37	28.8	0.32	49.9	38.4	27.8	33.9	c.l.
	-2	5.0	5.6	2.6	1.77	2.51	1.09	0.47		30		0.46	0.89	1.28	22.1	0.32	47.6	24.0	31.8	44.2	clay
Manufahi	-1	7.0	3.0	111.1	0	30.46	1.57	3.49	0.44	0	1.2		1.03	0.03	1.0	0.06	0.3	30.5	24.6	44.9	clay
	-2	7.5	3.0	93.9	0	31.67	1.42	3.92		0		1.37	1.54	0.00	0.3	0.06	0.0	20.3	28.8	50.9	clay
Liquisa	-1	7.1	3.4	138.3	0	6.98	1.88	0.42	0.40	0	4.1		0.88	2.45	72.2	0.44	35.0	43.4	33.7	22.9	loam
	-2	7.2	2.4	62.5	0	7.55	1.52	0.17	0.40	0	4.1	0.54	0.61	2.73	190.3	3.74	192.9	8.1	76.6	15.3	si.l.

[1)]Numbers in blue indicate low or very low levels: numbers in red indicate high or very high levels for cassava

[2)]s.l. = sandy loam c.l. = clay loam si.l. = silt loam

Table 4. Average cassava yield and plant stand of 14 varieties evaluated in Maliana site of Bobonaro, East Timor in 2000/2001.

Variety	Origin	Plant stand (%)	Root yield (t/ha)[1)]
1. Hanatee	Thailand	58	15.9
2. Rayong 2	Thailand	17	6.9
3. Adira 1	Indonesia	83	9.5
4. Mentega	Indonesia	50	10.0
5. Ketan	Indonesia	92	14.7
6. Tambak Urang	Indonesia	83	14.5
7. Randu	Indonesia	96	22.1
8. Malang 2	Indonesia	96	27.8
9. UB ½	Indonesia	92	26.7
10. SM 477-2	Indonesia	100	28.9
11. SM 881-5	Indonesia	92	26.3
12. OMM 90-3-100	Indonesia	96	35.4
13. Mentega	East Timor	54	14.9
14. Nona Metam	East Timor	79	13.5

[1)] Based on area (12 m^2) harvested.

In Aileu, cassava was growing quite well, but with poor growth of some varieties. There were no symptoms of nutrient deficiencies, but some young plants grew poorly and had yellow-orange leaves, most likely due to low temperature. Again, the two lines from RILET, CMM95-42-3 and CMM96-36-269 showed excellent growth. The local variety *Putih* (with light green leaves and green petioles) grew very well and seems well-adapted to low temperatures. Another local variety, also called *Putih* (with light-green leaves and red petioles) also seemed well adapted, in contrast to *Mentega*, which showed stunted growth at this high (960 masl) elevation.

In Betano, cassava was about two months old and growth was highly variable, with plants in many plots showing uniform yellowing of all leaves typical of Fe deficiency or salinity. Some leaves had border necrosis, which is also typical of severe Fe deficiency or salinity. The two local varieties, Manu Tolu (= Mentega?) and Lesu (= Putih?) showed severe yellowing of leaves, while many of the introduced varieties had poorly germinated or had died of Fe and/or Zn deficiency. Again, the line CMM95-42-3 showed excellent growth without any symptoms of micronutrient deficiencies.

Tables 5 and **6** show the results of two of these trials conducted in Baucau and Aileu, respectively (no yield data could be collected in Betano and Loes). **Table 5** shows that nine of the introduced varieties had significantly higher yields than the two local varieties in Baucau; CMM 96-08-44 produced the highest yield of 25.3 t/ha, compared with 10-14 t/ha for the two local varieties. In Aileu (**Table 6**) five varieties were significantly higher yielding than the best of the two local checks; OMM 90-03-100 produced a yield of 38.8 t/ha, while CMM 96-08-44 produced 29.2 t/ha, as compared to 9.5 and 15.8 t/ha for the two local varieties. Although these data are still preliminary and based on relatively few plants, the three trials harvested so far point to the high yield potential of OMM 90-03-100, followed by CMM 96-08-44, CMM 95-42-3 and CMM 96-36-269, which are all advanced breeding lines from RILET. Farmers involved in the harvest considered CMM 96-36-269, CMM 95-42-3 and SM 2361-1 the best to eat.

Table 5. Results of a cassava variety evaluation trial conducted in Don Bosco Technical School, Fatomaca, Baucau, East Timor in 2002.

	Evaluation [1]				No plants harvested			Yield (t/ha)			
	I	II	III	Av.	I	II	III	I	II	III	Av. I+II[2]
1. CMM 96-27-76	2	1	3	2.0	-	-	-	-	-	-	-
2. SM 2361-1	1	1	2	1.3	6	6	0	26.0	19.7	0	22.85ab
3. CMM 96-08-19	2	3	2	2.3	-	-	-	-	-	-	-
4. CMM 96-08-44	3	1	3	2.3	7	7	1	25.6	25.0	20.0	25.30a
5. CMM 96-36-255	4	3	3	3.3	5	5	4	25.0	25.4	16.3	25.20a
6. CMM 96-37-275	2	3	3	2.7	3	5	3	14.7	14.4	8.0	14.55cd
7. CMM 90-36-224	1	2	1	1.3	1	2	-	18.2	20.0	-	19.10bc
8. OMM 96-02-113	2	3	1	2.0	5	-	-	16.4	-	-	-
9. CMM 96-36-269	4	5	5	4.7	2	4	8	21.6	21.0	18.5	21.30ab
10. OMM 96-01-69	4	3	5	4.0	7	5	-	23.7	19.0	-	21.35ab
11. CMM 95-14-13	2	3	4	3.0	6	4	-	9.7	13.8	-	11.75d
12. CMM 95-42-3	5	5	5	5.0	3	9	6	22.0	19.5	19.3	20.75ab
13. CMM 96-25-25	3	3	3	3.0	4	2	-	18.8	22.5	-	20.65ab
14. OMM 96-01-93	4	2	3	3.0	6	4	-	14.2	15.0	-	14.60cd
15. OMM 90-03-100	3	4	4	3.7	3	2	-	19.7	22.5	-	21.10ab
16. local Mentega	2	2	2	2.0	6	5	7	13.6	14.5	13.6	14.05d
17. local Putih	2	2	4	2.7	4	4	4	10.2	10.0	9.5	10.10d

[1] evaluated March 26, 2002; 1 = bad: 5 = very good growth

[2] Duncan test at $\alpha = 0.05$

Table 6. Results of a cassava variety evaluation trial conducted in Aileu, East Timor in 2002.

	Evaluation [1]			No plants harv.		Yield (t/ha)			Yield (t/ha)
	I	II	Av.	I	II	I	II	Av.[2]	Av. 2 sites[2]
1. CMM 96-27-76	2	1	1.5	2	7	11.0	12.6	11.80 de	11.80 de
2. SM 2361-1	2	1	1.5	4	-	15.8	-	-	
3. CMM 96-08-19	4	3	3.5	7	7	18.9	16.3	17.60 cd	17.60 bcde
4. CMM 96-08-44	3	2	2.5	5	2	28.4	30.0	29.20 b	27.25 ab
5. CMM 96-36-255	4	3	3.5	9	8	10.9	16.9	13.90 de	19.55 abcde
6. CMM 96-37-275	3	3	3.0	4	5	22.5	24.0	23.25 bc	18.90 abcde
7. CMM 90-36-224	2	4	3.0	3	-	6.7	-	-	
8. OMM 96-02-113	3	2	2.5	5	7	18.0	18.3	18.15 cd	18.15 bcde
9. CMM 96-36-269	4	4	4.0	7	8	31.7	25.8	28.75 b	25.02 abc
10. OMM 96-01-69	5	1	3.0	7	3	3.7	1.7	2.70 f	12.02 de
11. CMM 95-14-13	3	3	3.0	7	-	25.0	-	-	
12. CMM 95-42-3	5	5	5.0	7	9	30.7	30.0	30.35 b	25.55 abc
13. CMM 96-25-25	3	2	2.5	7	8	24.3	28.8	26.55 b	23.60 abc
14. OMM 96-01-93	2	2	2.0	3	4	21.7	12.5	17.10 cde	15.85 bcde
15. OMM 90-03-100	4	2	3.0	7	7	44.7	32.9	38.80 a	29.95 a
16. local Mentega	4	3	3.5	8	7	14.0	17.7	15.85 cde	14.95 cde
17. local Putih	3	3	3.0	7	5	9.6	8.4	9.00 ef	9.55 e

[1] evaluated March 27, 2002; 1 = bad: 5 = very good growth

[2] Duncan test at $\alpha = 0.05$

2. Beans (*Phaseolus vulgaris*)

In Sept 2000, a collection of 14 varieties was introduced from Africa, mainly from Uganda, Malawi and Kenya. These were planted in five sites, i.e. Baucau, Los Palos, Maubisse, Aileu and Maliana. For various reasons, none of these trials produced reliable results.

In Dec 2001 another 11 bean varieties were introduced from Colombia. These were supposed to be planted in April 2002 (after the maize harvest) in three sites, i.e. Betano, Aileu and Maubisse, but due to drought these could not be planted. Instead, they were planted in Nov 2002 at the Aileu site, but seed did not germinate well. Beans will be planted in 5 rows, each of 5 m length, at a spacing of 50 cm between rows and 5-8 cm between plants in the row.

3. Other Pulses (Mungbean, Cowpea, Soybean)

In Sept 2000 two mungbean, two soybean and two cowpea varieties were introduced from Indonesia; two cowpea varieties (for green pods) from Thailand, and one soybean variety from Australia. These were planted in replicated trials in Baucau, Los Palos, Aileu, Maubisse and Maliana. The three pulses were planted in the same trials but grouped together according to species. They were planted in plots of 5 x 2.5 m with 50 cm between rows and 10-20 cm between plants.

Reliable results could be obtained only from Los Palos. **Table 7** shows that the varieties from Indonesia outyielded the local varieties as well as those from Thailand or Australia. Highest yields were obtained with the mungbean variety Kenari, the soybean variety Kawi and the cowpea variety KT-9.

Table 7. Yields of mungbean, soybean and cowpea in Los Palos, Lautem district, East Timor in 2000/01.

Crop/variety	Dry grain yield (t/ha)	Origin
1. mungbean Sriti	0.835	Indonesia
2. mungbean Kenari	0.889	Indonesia
3. mungbean local	0.782	East Timor
4. soybean Kawi	0.578	Indonesia
5. soybean Burangrang	0.529	Indonesia
6. soybean Lichhardt	0.507	Australia
7. cowpea KT-5	0.671	Indonesia
8. cowpea KT-9	0.795	Indonesia
9. cowpea KVC-7	0.640	Thailand
10. cowpea BS-6	0.755	Thailand

In Oct 2001 another collection of mungbean, soybean and cowpea varieties was introduced from RILET in Malang. These were planted in replicated trials in Baucau, Aileu, Betano and Loes. In Baucau, plant growth was excellent with possibly somewhat excessive vegetative growth. No yields could be obtained, however, due to excessive rain at time of pod ripening.

Table 8 shows that in Betano grain yields were very good, especially those of mungbean and soybean. There were no significant differences among mungbean varieties, but highest yields were obtained with mungbean variety Murai. Among soybean varieties, the Indonesian variety Kawi again outyielded the others and had a significantly higher yield than Burungrang. The commercial variety Willis had an intermediate yield, while the local variety Ked had a rather low yield of only 0.83 t/ha. Unlike the previous year, the cowpea variety KT-5 outyielded KT-9.

In Aileu the same collection of pulses grew well, but much less vigorously than in Baucau, probably due to the lower temperature at that high elevation. The commercial soybean variety Willis was rather weak, while some mungbean varieties showed yellowing and necrosis along leaf borders, most likely due to the cold. Results of this trial (**Table 9**) show that yields were much lower than in Baucau, probably due to poor adaptation to low temperature. Among mungbean varieties, the three Indonesian varieties Merpati, Perkutut and Kenari had significantly higher yields thant he local mungbean variety. Among soybean varieties, the Indonesian variety Kawi had again the highest yield, but this was not significantly different from the local variety Ked. Among cowpea varieties, the Indonesian variety KT-5 yielded more than twice as much as KT-9, or the two local varieties Hitam (black) and Merah (red).

In Loes, the pulses were growing vigorously, but no yield data could be obtained due to severe drought after flowering.

Table 8. Results of the grain legume trial conducted in Betano, Manufahi district of East Timor in 2001/02.

Crop/variety	Dry grain yield (t/ha)
1. mungbean Murai	1.547a
2. mungbean Merpati	1.433a
3. mungbean Perkutut	1.294a
4. mungbean Kenari	1.435a
5. soybean Kawi	1.608a
6. soybean Malabar	1.300ab
7. soybeanWillis	1.146ab
8. soybean Burangrang	0.808b
9. soybean local ked	0.833ab
10. cowpea KT-5	0.672a
11. cowpea KT-9	0.589a

Table 9. Results of the grain legume trial conducted in Aileu district of East Timor in 2001/02.

Crop/variety	Dry grain yield (t/ha)
1. mungbean Murai	0.269ab
2. mungbean Merpati	0.381a
3. mungbean Perkutut	0.332a
4. mungbean Kenari	0.314a
5. mungbean local	0.193b
6. soybean Kawi	0.878a
7. soybean Malabar	0.456cd
8. soybean Willis	0.561bc
9. soybean Barangrang	0.341d
10. soybean local ked	0.754ab
11. cowpea KT-5	0.773a
12. cowpea KT-9	0.384b
13. cowpea local hitam	0.302b
14. cowpea local merah	0.301b

CONCLUSIONS

The cassava, bean and pulses trials conducted in East Timor in 2000/01 suffered from many problems and limitations. Only one cassava and one pulses trial provided reliable results. In the second year of the Seeds-of-Life East Timor project, many of the problems experienced in the first year could be overcome, trials were better supervised, and the resulting data is therefore more reliable. In the cassava trials, some of the introduced breeding lines from Indonesia showed excellent growth in Baucau, Aileu and Betano, in spite of severely limiting Fe and Zn concentrations in the soil in Baucau and Betano; these lines significantly outyielded the local cassava varieties Mentega and Merah. The two pulses trials for which yield data could be obtained, indicate very high yields of mungbean and soybean in Betano, but much lower yields in Aileu, probably due to cold. Most introduced mungbean varieties, particularly Murai in Betano and Merpati in Aileu, significantly outyielded the local mungbean variety. Among soybean varieties, the Indonesian variety Kawi has consistently outyielded all other varieties, although the local variety Ked produced very good yields in Aileu. Among cowpea varieties, KT-5 outyielded all other varieties and had twice the yield of two local varieties in Aileu.

Seed and planting material of these varieties and crops should be kept and replanted, so as to confirm their superior performance during next year's trials, while seed and planting material of the most promising varieties should be quickly multiplied for on-farm testing with participation of local farmers.

Table 10. Results of the grain legume trial conducted in Don Bosco Technical School, Fatomaco, Baucau, East Timor in 2003.

		Grain yield (t/ha)			
		I	II	III	Av.
1.	mungbean Kendiri	1.69	1.75	1.71	1.72a
2.	mungbean Merpati	0.74	0.81	0.70	0.75d
3.	mungbean Murai	1.53	1.49	1.19	1.40b
4.	mungbean Perketut	0.83	1.16	1.27	1.09c
5.	mungbean Sriti	1.71	1.94	1.80	1.82a
6.	mungbean local variety	-	-	-	-
7.	soybean Sinabung				
8.	soybean Malabar				
9.	soybean Kawi				
10.	soybean Willis				
11.	soybean Kaba				
12.	soybean Sibayak				
13.	soybean local variety				
14.	cowpea KT4	-	-	-	-
15.	cowpea KT5	0.53	0.42	0.40	0.45c
16.	cowpea KT6	-	-	-	-
17.	cowpea KT7	1.20	1.26	0.92	1.13a
18.	cowpea KT9	0.78	0.96	0.79	0.84b
19.	cowpea local cam variety	-	-	-	-

Table 11. Fresh root yield of 17 cassava varieties and breeding lines from RILET, East Java, planted at Aileu experimental site, Aileu district of East Timor in 2002/03.

	Varieties[1)]	No. plants/plot[2)]		Root yield (t/ha)[3)]		
		I	II	I	II	Average
1.	CMM 96-27-76	24	25	35.5	31.8	33.65 ab
2.	SM 2361-1	24	25	38.1	34.6	36.35 a
3.	CMM 96-08-19	25	25	30.4	34.1	32.25 ab
4.	CMM 96-08-44	25	25	28.0	22.1	25.05 cdef
5.	CMM 96-36-255	25	20	20.4	29.4	24.90 cdef
6.	CMM 96-37-275	24	24	21.6	21.4	21.50 def
7.	CMM 90-36-224	23		22.1	20.0	21.05 ef
8.	OMM 96-02-113	24	24	19.1	20.9	20.00 f
9.	CMM 96-36-269	23	24	31.8	24.0	27.90 bcde
10.	OMM 96-01-69	24	23	17.5	21.4	19.45 f
11.	CMM 95-14-13	25	20	29.7	25.9	27.80 bcde
12.	CMM 95-42-3	24	25	28.8	30.0	29.40 bc
13.	CMM 96-25-25	26	25	27.5	29.2	28.35 bcd
14.	OMM 96-01-93	25	25	26.5	23.8	25.15 cdef
15.	OMM 90-03-100	25	25	27.9	22.0	24.95 cdef
16.	local Mentega	21	21	21.4	21.1	21.25 def
17.	local Mera	25	25	20.3	19.9	20.10 f

[1)] Using planting material of last year's trial in Aileu
[2)] in June 2003
[3)] Harvested at 10 MAP

Table 12. Root yield of eight local cassava varieties from Indonesia planted in Aileu experimental site, Aileu district of East Timor in 2002/03.

	Varieties[1)]	No. of plants/plot[2)]	Root yield[3)] (t/ha)
1.	local Sulawesi	25	28.7
2.	Daeng Mere	24	21.9
3.	Bogor-1	21	33.5
4.	Ranti	23	28.8
5.	Enak	25	25.2
6.	Klenteng	20	23.3
7.	Gempol	25	31.8
8.	Gading	24	36.2

[1)] Introduced from Wargiono on Oct 2002 for multiplication
[2)] in June 2003
[3)] Harvested at 12 MAP; only one replication

Table 13. Fresh root yield of 15 cassava varieties planted in Betano experimental site, Manufahi district, East Timor in 2003.

	Varieties[1]	No. of stakes planted/plot			No. plants harvested/plot			Root yield (t/ha)[2]			
		I	II	III	I	II	III	I	II	III	**Av.**
1.	CMM 96-27-76	9	9	9	9	9	6	110.39	71.67	20.39	**67.48**
2.	local Lesu	16	16	16	15	16	11	49.78	42.97	27.34	**40.03**
3.	CMM 96-08-19	16	16	15	16	13	11	56.22	40.87	83.77	**60.29**
4.	CMM 96-08-44	16	16	16	12	11	11	66.66	53.94	40.28	**53.63**
5.	CMM 96-36-255	16	16	16	10	16	9	49.37	37.56	29.00	**38.64**
6.	CMM 96-37-275	16	16	11	14	13	10	42.16	17.34	51.95	**37.15**
7.	CMM 96-36-224	10	10	10	10	9	11	60.85	103.35	107.05	**90.42**
8.	OMM 96-02-113	8	8	7	6	7	5	82.87	73.00	61.50	**72.46**
9.	CMM 96-36-269	16	16	16	15	16	15	68.78	69.22	56.72	**64.91**
10.	OMM 96-01-69	16	16	16	16	15	10	85.59	60.28	50.19	**65.35**
11.	CMM 95-14-13	16	16	16	11	14	10	44.81	47.16	27.87	**39.95**
12.	CMM 95-42-3	16	16	16	14	14	7	44.72	49.19	42.34	**45.42**
13.	CMM 96-25-25	16	16	16	16	16	13	64.63	81.34	57.00	**67.66**
14.	OMM 96-01-93	9	9	9	8	9	7	134.67	78.05	94.22	**102.31**
15.	OMM 90-03-100	16	16	16	16	15	16	90.00	78.06	79.44	**82.50**
	Average							**70.10**	**60.27**	**55.27**	**61.88**

[1] Using planting material of last year's trial in Betano
[2] Root yield calculated on the basis of number of stakes planted per plot; harvested at 9 MAP

Table 14. Effect of foliar applications of Fe and Zn, applied at one month after planting, on the fresh root yield of five cassava varieties planted in Betano, Manufahi district, East Timor in 2003.

Treatments			Root yield (t/ha)			
			I	II	III	**Average**
Control	– Variety	2	49.78	42.97	27.34	**40.03**
		5	49.37	37.56	29.00	**38.64**
		10	85.59	60.28	50.19	**65.35**
		12	44.72	49.19	42.34	**45.42**
		13	64.63	81.34	57.00	**67.66**
+ foliar Zn applic.	– Variety	2	43.03	47.22	14.59	**34.95**
		5	59.97	40.50	45.22	**48.56**
		10	56.66	38.09	43.63	**46.13**
		12	51.47	35.00	28.56	**38.34**
		13	78.97	72.22	75.16	**76.45**
+ foliar Fe applic.	– Variety	2	46.75	38.19	27.78	**37.57**
		5	41.25	34.22	45.06	**40.18**
		10	67.22	60.59	65.47	**67.43**
		12	54.34	32.63	41.41	**42.79**
		13	55.41	67.44	64.56	**62.47**
Average			**56.61**	**49.16**	**44.02**	**49.93**

	Variety	Fresh root yield (t/ha)			
		Control	+ Zn	+ Fe	Average
2.	local Lesu	40.03	34.95	37.57	37.52
5.	CMM 96-36-255	38.64	48.56	40.18	42.46
10.	OMM 96-01-69	65.35	46.13	64.43	58.64
12.	CMM 95-42-3	45.42	38.34	42.79	42.18
13.	CMM 96-25-25	67.66	76.45	62.47	68.86
	Average	**51.42**	**48.89**	**49.49**	**49.93**

Table 15. Yields of cassava varieties introduced and tested at various locations in East Timor during 2001, 2002 and 2003.

		Cassava root yield (t/ha)						
Variety	Origin	Maliana 2001	Baucau 2002	Aileu 2002	Aileu 2003	Aileu 2003	Betano 2003	Betano 2003
local Mentega	East Timor	14.9	14.05	14.95	21.25			
local Nona Metam	East Timor	13.5	-	-	-			
local Putih	East Timor		10.10	9.55				
local Merah	East Timor				20.10			
local Lesu	East Timor						40.03	37.52
SM 477-2	CIAT, Colombia	28.9						
SM 881-5	CIAT, Colombia	26.3						
SM 2361-1	CIAT, Colombia		22.85	22.85	36.35		-	
Hanatee	Thailand	15.9						
Rayong 2	DOA, Thailand	6.9						
UB ½	UNIBRAW, Indonesia	26.7						
Adira 1	RILET, Indonesia	9.5						
Mentega	RILET, Indonesia	10.0						
Ketan	RILET, Indonesia	14.7						
Tambak Urang	RILET, Indonesia	14.5						
Randu	RILET, Indonesia	22.1						
Malang 2	RILET, Indonesia	27.8						
CMM 90-36-224	RILET, Indonesia		19.10	19.10	21.05		90.42	
CMM 95-14-13	RILET, Indonesia		11.75	11.75	27.80		39.95	
CMM 95-42-3	RILET, Indonesia		20.75	25.55	29.40		45.42	42.18
CMM 96-08-19	RILET, Indonesia		-	17.60	32.25		60.29	
CMM 96-08-44	RILET, Indonesia		25.30	27.25	25.05		53.63	
CMM 96-25-25	RILET, Indonesia		20.65	23.60	28.35		67.66	68.86
CMM 96-27-76	RILET, Indonesia		-	11.80	33.65		67.48	
CMM 96-36-255	RILET, Indonesia		25.20	19.55	24.90		38.64	42.46
CMM 96-36-269	RILET, Indonesia		21.30	25.02	27.90		64.91	
CMM 96-37-275	RILET, Indonesia		14.55	18.90	21.50		37.15	
OMM 90-03-100	RILET, Indonesia	35.4	21.10	29.95	24.95		82.50	
OMM 96-01-69	RILET, Indonesia		21.35	12.02	19.45		65.35	58.64
OMM 96-01-93	RILET, Indonesia		14.60	15.85	25.15		102.31	
OMM 96-02-113	RILET, Indonesia		-	18.15	20.00		72.46	
local Sulawesi	CRIFC, Indonesia					28.7		
Daeng Mere	CRIFC, Indonesia					21.9		
Bogor-1	CRIFC, Indonesia					33.5		
Ranti	CRIFC, Indonesia					28.8		
Enak	CRIFC, Indonesia					25.2		
Klenteng	CRIFC, Indonesia					23.3		
Gembol	CRIFC, Indonesia					31.8		
Gading	CRIFC, Indonesia					36.2		

Table 16. Yields of mungbean, soybean, and cowpea introduced and tested at various locations in East Timor during 2001, 2002 and 2003.

Species	Variety	Origin	Los Palos 2000/01	Betano 2001/02	Aileu 2001/02	Baucau 2002/03
Mungbean	Sriti	RILET, Indonesia	0.835			1.82 a
	Kenari	RILET, Indonesia	0.889	1.435 a	0.314 a	
	Murai	RILET, Indonesia		1.547 a	0.269 ab	1.40 b
	Merpati	RILET, Indonesia		1.433 a	0.381 a	0.75 d
	Perkutut	RILET, Indonesia		1.294 a	0.332 a	1.09 c
	Kendiri	RILET, Indonesia				1.72 a
	local	East Timor	0.782		0.193 b	0
Soybean	Lichhardt	Australia	0.507			
	Kawi	RILET, Indonesia	0.578	1.608 a	0.878 a	
	Burangrang	RILET, Indonesia	0.529	0.808 b	0.341 d	
	Malabar	RILET, Indonesia		1.300 ab	0.456 cd	
	Willis	RILET, Indonesia		1.146 ab	0.561bc	
	local Kediri	East Timor		0.833 ab	0.754 ab	
Cowpea	KVC-7	Thailand	0.640	0.589 a		
	BS-6	Thailand	0.755			
	KT-4	RILET, Indonesia				0
	KT-5	RILET, Indonesia	0.671		0.773 a	0.45 c
	KT-6	RILET, Indonesia				0
	KT-7	RILET, Indonesia				1.13 a
	KT-9	RILET, Indonesia	0.795	0.672 a	0.384 b	0.84 b
	local hitam	East Timor			0.302 b	
	local merah	East Timor			0.301 b	
	local cam	East Timor				0