

Cassava Production Technologies to Obtain High and Sustainable Yields

Reinhardt Howeler and Tin Maung Aye

Cassava Production Areas

Cassava is generally grown not in areas where the crop grows best, but in those areas where it grows better than other competing crops

Cassava grows well in tropical and subtropical areas up to about 25° N and S, with 1000-2000 mm annual rainfall, and with 4-6 months of dry season

Cassava grows best in well-drained sandy loam to clay loam soils, with pH 4.5-7.5 and with low-intermediate levels of OM, P and K

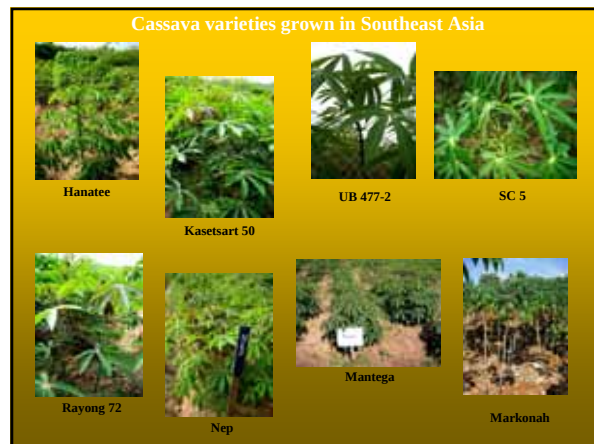


In many areas animal raising is integrated within crop-based farming systems, but one of the main constraints is the lack of feed during the dry season, both energy and protein sources

Feeding both cassava roots and leaves, either dried or as silage, will provide energy and protein, thus improving animal production and raising farmers income



How can farmers increase their cassava yields in a sustainable way?



What is the best time to plant
and to harvest cassava?

Table 6. Average fresh root yield of Rayong 1 as effected by age at harvest when planted at Rayong Field Crops Research Center, 1975-1979.

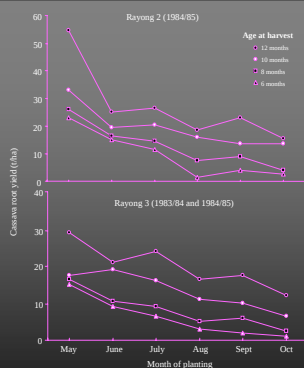
Age at harvest (months)	Fresh root yield (t/ha)	Dry root yield (t/ha)	Starch yield (t/ha)
8	16.19 f ¹⁾	6.44 f	2.31 f
10	23.06 e	8.31 e	4.81 e
12	31.31 d	10.69 d	5.94 d
14	37.56 c	13.06 c	7.38 c
16	41.50 b	15.00 b	8.69 b
18	45.25 a	16.44 a	9.19 a

¹⁾Mean separation within each column: DMRT, 0.01
Source: Sinthuprama et al., 1983.

Table 8. Starch content (%) of four cassava varieties planted in May and harvested at monthly intervals at Sri Racha Research Station in 1990/1994. Numbers in parenthesis indicate the age (MAP) at harvest.

Variety	Month at harvest								
	Sept (4)	Oct (5)	Nov (6)	Dec (7)	Jan (8)	Feb (9)	Mar (10)	Apr (11)	May (12)
Rayong 1	9.4	16.7	19.4	19.4	19.8	22.2	14.7	10.6	12.0
Sriracha 1	12.5	18.0	21.5	22.0	23.7	23.0	18.4	15.8	19.1
Kasetsart 50	8.8	16.8	22.5	24.5	24.0	24.8	19.0	16.0	18.5
Rayong 60	10.6	14.0	18.2	19.9	17.2	21.3	13.1	9.2	10.2
Average	10.3	16.4	20.4	21.4	21.2	22.8	16.3	12.9	14.9

Source: Vichukit et al., 1994.



Effect of month of planting and age at harvest on root yields of cassava cultivars Rayong 2 and Rayong 3 planted at Rayong Field Crops Research Center in 1983-1985.
Source: Field Crops Research Institute, Annual Report 1986.

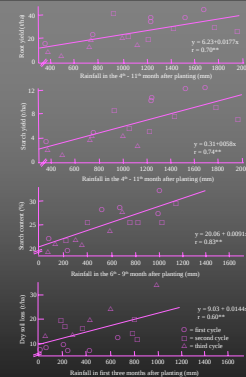
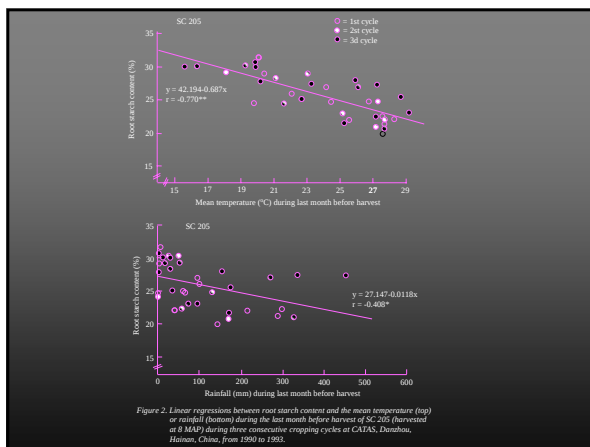
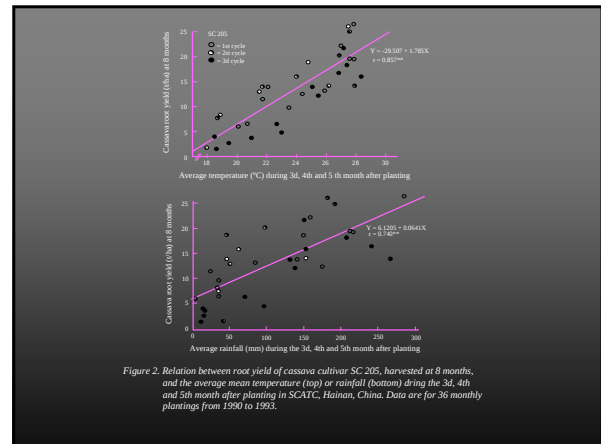
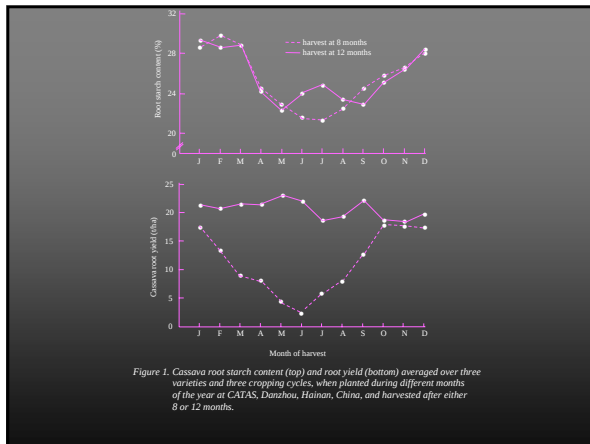


Figure 1. Linear regressions between cassava root yield, starch yield, starch content and dry soil loss due to erosion and the rainfall received during certain periods of the crop cycle when cassava, cv Rayong 50, was grown at bimonthly intervals for three complete cropping cycles on 4.2% slope at Rayong Research Center in Thailand from 1994 to 1996.
Source: CIAT, 1996 b.



•The best times to plant and harvest are

- Plant as early as possible at the beginning of the wet season, and harvest in the middle of the dry season (at about 10-11 months), or
- Plant towards the end of the wet season and harvest in the middle of the next dry season (at about 16 months)
- In subtropical climates, plant in the very early spring and harvest in early to late winter, or plant at any time and harvest after at least 12 months, but not in the hottest time of the year



Table 17. Effect of stem age, stake length and part of stem from which stakes are cut on survival of Rayong 1 at Rayong Field Crops Research Center, 1974-1976.

	Stem age (months)		
	8	10	12
Stem length (cm)	201	266	282
# Buds/stem	93	113	137
Stake length (cm)	Survival (%)		
5	48.6		
10	77.5		
15	88.8		
Part of stem			
Upper	58.7		
Middle	92.1		
Lower	98.6		

Source: Chankam, 1994.

Table 18. Plants survival (%) from stakes stored under different conditions and for various periods at Rayong Field Crops Research Center, 1976-1978.

Storage time (days)	Storage method		
	Under shade	In sun	Covered with leaves
0	95.6	95.3	96.5
15	93.5	93.4	91.6
30	83.4	84.3	87.9
45	80.0	55.9	58.4
60	57.5	48.9	50.0
75	49.2	31.9	43.1
90	44.9	28.9	35.9
105	43.2	21.0	22.1

Source: Sinthuprama et al., 1984.

Planting stakes

- Length 15-20 cm (7-10 nodes)
- From stems of 8-12 months old plants
- Size 1.5-2.5 cm diameter



Cutting stems into stakes



**Do not use
oversize or thin
stakes, nor forked
stakes**



Manual planting

Planting distance
0.8 x 0.8 to 1 X 1 m

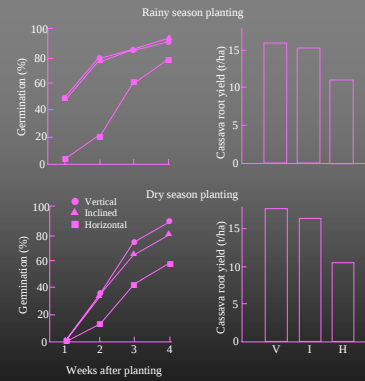


Mechanized planting

Planting methods

- Horizontal
- Vertical, buds facing up
- Slanted, buds facing up

(plant only one stake per site)



On fertile soil cassava can produce very high yields



In Pati, Indonesia



In Hainan, China

But most cassava is grown on infertile soils ...



...and most cassava farmers are smallholders





P deficiency in Xieng Khouang, Laos



K deficiency in Cambodia

The fertility of the soil needs to be maintained



Chemical fertilizers



Animal manure

- Chemical fertilizers
 - Organic manures
 - Green manures
- (depending on what is available and most economic)



Green manure

Table 9. Average nutrient contents of various manures, composts, wood ash, and chemical fertilizers.

Source of manure	Moisture (%)	N	P	K	Ca	Mg	S
(% of dry matter)							
Cattle manure	68.2	1.85	0.81	1.69	1.54	0.62	0.29
Pig manure	60.0	2.04	1.38	1.38	-	-	-
Chicken manure	43.0	2.91	1.37	1.54	4.56	0.83	-
Sheep manure	-	3.00	0.62	2.68	1.72	0.86	0.43
Human manure	-	1.20	0.06	0.21	-	-	-
City/rural compost	-	1.16	0.37	0.90	-	-	-
Rice straw compost	73.7	1.07	0.19	0.69	-	-	-
Peanut stems + leaves compost	58.6	0.81	0.10	0.38	-	-	-
Water hyacinth	-	2.00	1.00	2.30	-	-	-
Wood ash	-	-	0.87	4.17	23.2	2.10	0.40
15-15-15	0	15.00	6.55	12.50	0	0	0
Urea	0	45	0	0	0	0	0
Triple superphosphate	0	0	20	0	14	0	0
Potassium chloride	0	0	0	50	0	0	0

Source: Howeler, 2001b.

Table 16. Effect of various fertilization alternatives on the yields of cassava and intercropped maize, as well as gross and net income in Jatikerto Station in Malang, East Java in 2005/06. (2nd year)

Treatments		Maize yield (t/ha)	Cassava yield (t/ha)	Gross income	Fertilizer costs (mil. Rp/ha)	Product. costs (mil. Rp/ha)	Net income
N-P-O-K ₂ O (kg/ha)	Organic (t/ha)						
1. 0-0-0	0	1.10	10.96	4.72	0	4.10	0.62
2. 135-0-0	0	1.93	35.60	13.52	0.45	7.01	6.51
3. 135-50-0	0	2.07	36.80	14.05	0.69	7.37	6.68
4. 135-50-100	0	2.10	37.47	14.30	1.27	8.02	6.28
5. 0-0-0	10 Cattle manure	1.66	26.53	10.32	2.00	7.65	2.67
6. 0-0-0	10 Compost	1.63	22.67	9.05	1.00	6.27	2.78
7. 135-0-0	5 Cattle manure	2.26	35.63	13.89	1.45	8.01	5.88
8. 135-0-0	5 Compost	1.97	39.33	14.75	0.95	7.88	6.87
9. 135-50-0	5 Compost	1.87	39.07	14.56	1.19	8.10	6.46
10. 135-0-0	5 Sugar mud ²⁾	1.67	33.73	12.63	0.95	7.32	5.31



Be aware!

Cassava can cause serious soil erosion, even on gentle slopes.....

...if large amounts of run-off accumulate in natural drainage ways



Table 5. Effect of various crops and cropping systems on dry soil loss due to erosion and on net income during an 8 month cropping cycle on 5% slope in Tamanbogo, Lampung, Indonesia. Data are average values for two years (1994-1996).

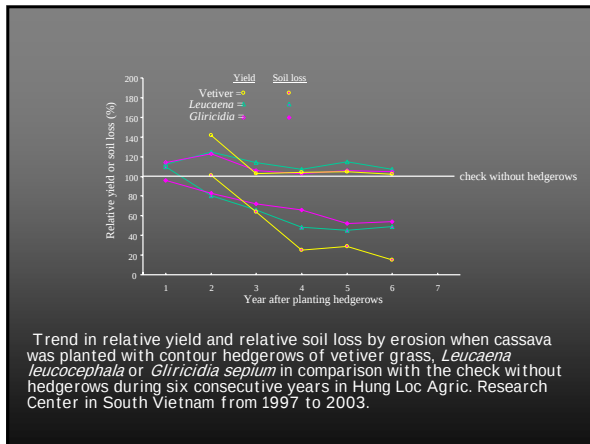
	Dry soil loss (t/ha)	Net income ¹⁾ ('000 Rp/ha)
Without fertilizers		
Cassava	41.92	322
Rice-soybean	26.29	570
Maize-maize	30.64	159
With fertilizers		
Cassava	29.06	804
Rice-soybean	24.31	1,477
Maize-maize	24.98	892
Peanut-peanut	17.92	2,488
Soybean-soybean	27.61	2,031
Cassava + maize + rice - soybean	19.60	1,300

¹⁾ Net income = total crop value minus fertilizer costs

There are many simple ways to control erosion.....



...and simple ways to measure erosion in farmers' fields



Weed Control

Cassava is a weak competitor, and its growth and yield are seriously reduced by weed competition

Cassava fields need to be weeded at least 2-3 times during the crop cycle, usually at 1, 2 and 3 months after planting

Many alternative ways to grow cassava on farmers' fields

Intercropping cassava with other crops can:

- suppress weeds
- reduce pests and diseases
- conserve soil and water
- increase farmer's income

Be aware of the principle factors of intercropping!

- the degree of competition between crops, and
- socio-economic considerations

Competition and Complementarity

Intercropping will generally decrease the yields of each crop but increase the total income from all crops

Intercropping

- Peanut
- Soybean
- Sweet potato



Intercropping

- Upland rice
- Upland rice + maize
- followed by peanut



Root harvest

- Simple tools such as digging stick, hoe, or narrow spade



- Simple harvesting tools



Harvesting can be done by either simple tools or by tractor-mounted equipment



The planting of high-yielding varieties and the use of improved agronomic practices are the best ways to increase cassava yields and farmer's income



Our Future!!!!