An Innovative Ratooning Technique for Rapid Propagation of Cassava in CÔTE D'IVOIRE

By

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Abstract

Cassava is grown on approximately 80 % of the territory of Côte d'Ivoire. It constitutes the second food crop after yam with a total production estimated at 1.5 million t. It becomes both a subsistence and cash crop for farmers. The low rate of current propagation of cassava limits its extension and the on farm diffusion of new cultivars. To overcome this constraint, researchers carried out an experiment during two consecutive years in Côte d'Ivoire. It consisted in taking cuttings on growing plants at 10 cm, 35 cm and 60 cm from the soil of three cassava cultivars 7 months after planting. Control was non-ratoon plants. Plants and tuberous roots were harvested 8 month after ratooning. Results showed that at 35 and 60 cm from soil, the loss in dry matter was significant. However, at 10 cm from soil, the rates of loss in yield and dry matter of tuberous roots were low and were estimated at less than 3.5%. Moreover, at that level, the quantity of cuttings was the highest. Applying this technique, farmers will solve the lack of available on farm planting material.

Introduction

Cassava is mainly grown for its tuberous roots, which constitute an important source of energy for consumers. Leaves are sometimes used as vegetable. Cassava is vegetatively propagated by cuttings and sexual reproduction is applied in research stations for cultivar improvement. The low rate of current fi eld propagation (10) prompted the development of techniques of rapid multiplication, namely, micro-propagation by in culture and mini-propagation. These techniques signifi cantly increase rate of multiplication. However, these innovations require fi nancial means and technical skills, which limit their adoption. Moreover, they do not permit farmers to have high quantity of quality tuberous roots. In Côte d'Ivoire, the lack of planting material constitutes a constraint to the adoption of cassava crop by farmers. Cuttings are sold in form of faggots whose cost can exceed FCFA 20000 (US$ 40) for 1 ha of planting (Ndabalishye 1995). Experimentation was therefore conducted at research station during two successive years in Côte d'Ivoire to determining levels of ratooning of cassava plants, which permit to obtain cuttings before root harvest without signifi cantly deteriorating the essential traits related to tuberous roots.

Material and methods

The plant materials included one landrace (Yacé) and two local improved cultivars (84/701 and 89/130) (Table 1). Experiments were carried out at a research station at Bouaké in the Center of Côte d'Ivoire from 1996 to 1998. The experimental design was a split-plot arrangement with four replications. The principal factor and the secondary factor were cultivar and ratooning respectively. Four levels of ratooning were defi ned, namely (i) control (non- ratoon), (ii) ratooning at 60 cm from soil, (iii) ratooning at 35 cm from soil, and (iv) ratooning at 10 cm from soil. Each useful plot comprised 21 plants in 21 m² with 1 m between rows and 1 m between plants. Cuttings were horizontally planted in ploughed soil. Tuberous roots were harvested 15 months after planting.

Table 1. Traits of cassava cultivars used in this experiment

Cultivar	Origin	Yield (t ha^{-1})	Dry matter (%)	Resistanc To mosaic	Resistance to mealybugs	Resistance to mites
Yacé	On farm (CI)	20	40	weak	weak	weak
84/701	IDESSA (CI)	30	35	moderate	good	good
89/130	IDESSA (CI)	28	40	moderate	moderate	moderate

CI: Côte d'Ivoire. IDESSA: Institut des Savanes

The observations and measurements on plants were as follows:

• Number of cuttings At ratooning, 7 months after planting, the number of suitable cuttings that can provide the ratoon plants was recorded. The control was not taken into account in the analysis of variance since it remained intact.

• Yield in fresh tuberous root At harvest all tuberous roots per plot were weighed and yield was noted.

• Rate of dry matter At harvest samples of tuberous roots were taken in plots. The roots were peeled and cut into small

washers of approximately 2 g each. Samples of 200 g were spread out over aluminium foil and introduced into a drying oven at 90 ℃ during 24 hours. Root dry matter was weighed. Statistical analysis Data were subjected to an analysis of variance using GLM (General Linear Models Procedure) and means tested through the least signifi cant difference at 5 % level.

Results and Discussion

First year (1996/1997) Number of cuttings There was a signifi cant difference between the three cutting levels. The ratooning at 10 cm from soil could provide the greatest number of suitable cuttings with an average of 4.7 cuttings per plant whereas the weakest average (1.5 cuttings per plant) was recorded at 60 cm from the soil (Table 2). For a density of 10,000 plants ha-1 and a ratooning at 10 cm from the soil, it is possible to obtain 47,000 cuttings, which can be planted on a surface of at least 4 ha. A ratooning at 60 cm produces only 15,000 cuttings, i.e., being able for planting 1.5 ha. The clone 89/130 provided the greatest number of cuttings with 3.6 cuttings per plant (Table 3).

Table 2. Number of cuttings from cassava plants at 3 ratooning level 7 months after planting

Ratooning levels	Number of cuttings per plant		
	1996/1997	1997/1998	1996/1998
60 cm 35 cm 10 cm	1.5 3.2 4.7	1.0 2.7 4.9	1.2 3.0 4.8
Least significant difference (5%) *Mean* Coefficient of variation (%)	0.7 3.1 27	0.5 2.8 19	0.4 3.0 23

Yield The yields did not vary signifi cantly across rationing levels neither if compared with the control, although losses of about 6.5%, 6.3% and 0.1% were recorded for the ratoon plants at 10, 35 and 60 cm from the soil, respectively (Table 4). There were signifi cant differences amongst cultivars: the clone 84/701 recorded the best yield with 20.87 t ha-1 viz. a viz. 17.38 t ha-1 for clone 89/130 and 13.87 t ha-1 for the landrace Yacé.

Table 3. Number of cuttings obtained from 3 cassava cultivars 7 months after planting

	Number of cuttings per plant		
Cultivar	1996/1997	1997/1998	1996/1998
Yacé	2.7	2.9	2.8
84/701	3.0	3.2	3.1
89/130	3.6	2.4	3.0
Least significant difference (5%)	0.7	0.5	0.4
Mean	3.1	2.8	3.0

Table 4. Influence of ratooning levels on cassava traits

Ratooning levels	WTRP (kg plant^{-1})	WTR (kg per tuberous roots)	Yield (t ha^{-1})	IRY[1]	Dry matter (%)	IRM[2] (%)
Control	2.04	0.51	17.96	—	38.3	—
60 cm	1.88	0.48	17.94	- 0.1 %	36.9	- 3.7
35 cm	1.89	0.44	16.82	- 6.3 %	36.1	- 5.7
10 cm	1.96	0.52	16.79	- 6.5 %	36.2	- 5.5
LSD (5%)	0.27	0.06	2.82	—	2.5	—
Mean	1.94	0.49	17.37	—	36.9	—
Coefficient of variation (%)	17	14	19	—	8	—

LSD: Least significant difference. WTRP: weight of tuberous roots per plant. WTR: weight of tuberous roots
[1] IRY: increase rate of yield compared with control. [2] IRM: increase rate of dry matter compared with control

Rate of dry matter The stem cutting on plants did not present a signifi cant effect on dry matter in spite of losses of about 3.7 %, 5.7 % and 5.5 % for the ratoon plants at 60, 35 and 10 cm from the soil, respectively (Table 4). These results did not agree with those reported by Osiname and Landu (1992), who showed that leaf harvest signifi cantly increased dry mattercontent of tuberous roots of cultivars Kinuani and Mpelo-longi; but it did not have a signifi cant effect on cultivar F100. The non-signifi cant losses of dry matter could be explained by the fact that the ratoon plants could compensate the losses during the 8-month period from rationing to harvest due to the regeneration of new organs such as leaves or stems. Dry matter of Yacé and 89/130 were almost identical and signifi cantly higher than that of variety 84/701 (Table 5). The dry matter rates can be comparable to those shown in Table 1; i.e., without ratooning.

Table 5. Agronomic traits of 3 cassava cultivars 15 months after planting

	Yield (t ha^{-1})			Rate of dry matter (%)		
Cultivar	1996/1997	1997/1998	1996/1998	1996/1997	1997/1998	1996/1998
Yacé	13.87	21.43	17.65	38.5	34.8	36.6
84/701	20.87	32.53	26.70	34.8	37.2	36.0
89/130	17.38	27.98	22.68	37.3	41.4	39.3
LSD (5%)	2.44	1.70	1.45	2.2	1.3	1.2
General mean	17.37	27.31	22.34	36.9	37.8	37.3

LSD: Least significant difference

Second year (1997/1998) Number of cuttings The number of cuttings signifi cantly varied through ratooning levels. The highest number of cuttings (4.9 cuttings per plant) was obtained when the plants were ratooned at 10 cm from the soil. The ratooning at 60 cm can only provide an average of one cutting per plant (Table 2).

Yield Non-signifi cant losses of yield were recorded; about 3.6% for 60 cm and 5.2 % for 35 cm viz a viz. the control. Ratooning at 10 cm increased, although non-signifi cantly, yield –about 2.6 % versus the control (Table 6). The superior yield of cuttings at 10 cm could be explained by the repeated defoliation of control plants caused by locusts, and by the combined action of mealybugs, mites and mosaic disease, which were less on ratoon plants at 10 cm than on ratoon plants at 60 cm and 35 cm. The cultivar 84/701 recorded the best yield with 32.53 t ha-1 versus 27.98 t ha-1 of cultivar 89/130 and 21.43 t ha-1 for landrace Yacé (Table 5).

Rate of dry matter Ratooning did not affect signifi cantly dry matter, although losses of 3.6, 1.8 and 0.5 % were recorded respectively for cuttings at 60, 35 and 10 cm from the soil (Table 6). The small coeffi cient of variation (5 %) indicates the reliability of the data collected. Dry matter of landrace Yacé fell signifi cantly to 34.8 % versus the initial 40 % 7 months after planting (Table 1), and became the weakest (Table 5). This fall could result from the use of a part of starch stored in the tuberous roots for the synthesis of new leaves further to the repeated devastation of organs caused preferentially by locusts on the landrace Yacé.

Combined over two years (1996-1998) Number of cuttings There were 4.8, 3 and 1.2 cuttings per plant at 10, 35 and 60 cm ratooning from the soil, respectively. The analysis of variance indicated that numbers of cuttings were signifi cantly different according to rationing levels (Table 2). The number of cuttings did not however vary signifi cantly among cultivars. The general average was 3 cuttings per plant (Table 3).

Yield The ratooning did not have a signifi cant effect on tuberous root yield and average weight. Non-signifi cant losses of 2.2%, 5.5% and 0.1% were recorded for cuttings at 60, 35 and 10 cm from the soil, respectively (Table 7). Previous research by Dahniya (1981), Osiname and Landu (1992), and Lutete et al. (1992) revealed that leaf harvest signifi cantly reduced tuberous root yield. Dahniya (1981) showed that the harvest of leaves at 1-, 2- or 3-month intervals reduced yield by 56 to 76%, 34 to 62 %, and 15 to 32 %, respectively. Lutete et al. (1992) reported 49.2% yield loss if three successive harvests were carried out. In our research, the non-signifi cant yield losses could result from the increased photosynthetic activity of leaves regenerated after ratooning. For the period from cutting to root harvest, this activity would favour the plants and compensate carbohydrate reserves, which were used for the synthesis of new organs (e.g. leaves, stems). There was a signifi cant difference between yield of the two cultivars and the landrace. The clone 84/701 was the highest yielding (26.7 t ha-1) followed by 89/130 (22.68 t ha-1) and Yacé (17.65 t ha-1) respectively (Table 5).

Table 6. Influence of rationing levels on cassava traits

Ratooning levels	WTRP (kg plant^{-1})	WTR (kg per tuberous roots)	Yield (t ha^{-1})	IRY [1] (%)	Dry matter (%)	IRM [2] (%)
Control	3.26	0.57	27.74	—	38.4	—
60 cm	3.18	0.59	26.75	- 3.6	37.0	- 3.6
35 cm	3.23	0.58	26.31	- 5.2	37.7	- 1.8
10 cm	3.42	0.59	28.45	2.6	38.2	- 0.5
LSD (5 %)	0.30	0.05	1.97	—	1.5	—
Mean	3.27	0.58	27.31	—	37.8	—
Coefficient of variation (%)	11	10	9	—	5	—

LSD: Least significant difference. WTRP: weight of tuberous roots per plant. WTR: weight of tuberous roots
[1] IRY: increase rate of yield compared with control. [2] IRM: increase rate of dry matter compared with control

Table 7. Influence of rationing levels on cassava trait across two years (1996-1998)

Ratooning levels	WTRP (kg plant^{-1})	WTR (kg per tuberous roots)	Yield (t ha^{-1})	IRY [1] (%)	Dry matter (%)	IRM [2] (%)
Control	2.65	0.54	22.85	-	38.4	-
60 cm	2.57	0.55	22.34	- 2.2	36.9	- 3.9
35 cm	2.56	0.51	21.56	- 5.6	36.9	- 3.9
10 cm	2.65	0.54	22.62	- 0.1	37.2	- 3.1
LSD (5 %)	0.20	0.04	1.68	-	1.4	-
General mean	2.61	0.53	22.34	-	37.3	-
Coefficient of variation	13 %	12 %	13 %	-	7 %	-

LSD : Least significant difference. WTRP : weight of tuberous roots per plant. WTR : weight of tuberous roots
[1] IRY: increase rate of yield compared with control. [2] IRM: increase rate of dry matter compared with control

In summary, this research showed that it is possible to ratoon cassava plants at 10 cm from the soil surface 7 months after planting without affecting yield and dry matter in tuberous roots. Ratooning of plants at 60 and 35 cm caused however a signifi cant loss of dry matter (3.9%). At 10 cm cutting, the number of cuttings was the highest and losses of yield and dry matter were non-signifi cant. On poor soils, the ratoon plants at 10 cm could however need increased fertilizer requirements to improve growth and root yield.

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