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Distribution of improved varieties of cassava and potential impact on root yield and disease reduction in Nigeria

R.U. Okechukwu[1], I.A. Kehinde[2], C.G. Afolabi[1], B. James[1] , and C. Egesi[3]

[1]International Institute of Tropical Agriculture, Ibadan, Nigeria
[2]University of Agriculture, Abeokuta, Nigeria
[3]National Root Crops Research Institute, Umudike, Nigeria

Corresponding Author: R.U. Okechukwu
Email: r.okechukwu@cgiar.org

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Abstract

Eleven improved varieties project were multiplied in 2009 by primary producers associated with the USAID/ IITA project *Unleashing the Power of Cassava in Africa in response to the Food Price Crisis* (UPoCA) in seven States of Nigeria. In 2010, stems from these multiplication farms were distributed to farmers in these States. Prior to the distribution exercise a baseline survey was conducted on 630 farm families to ascertain among other issues their perception of cassava mosaic disease and other cassava pests. At the end of the harvest 2010 planting season, a survey of a subset of the recipients (80 villages) showed that the farmers are better informed and are replacing local varieties with improved varieties but would still need more extension service support on the best time to harvest these varieties to minimize losses due to rot.

Key words: Cassava, UPoCA, seed system, cassava mosaic disease, root rot, variety spread

Introduction

The Project *Unleashing the Power of Cassava in Response to Food Price Crisis* (UPoCA), funded by United States Agency for International Development (USAID) and implemented by IITA was a 2-year multi-country Special Project. It was implemented in Ghana, Malawi, Mozambique, Nigeria, Sierra Leone, Democratic Republic of Congo, and Tanzania. One major objective is the rapid mass propagation of improved and multiple pest/disease resistant varieties. The introduction and dissemination of these high yielding varieties and their subsequent adoption is expected to increase cassava yield by 30% above baseline figures.

Cassava (*Manihot esculenta* Crantz) is an important root crop in Nigeria. It serves as a staple for many households and recently is being promoted as an industrial crop. Nigeria still remains the largest producer of cassava in the world but the cultivation of low yielding varieties and ineffective extension systems has led to a wide gap between farmers potential and actual yields.

In 2002, IITA raised the alarm about the threat of the new Ugandan virus strain (EACMV-Ug2) of cassava mosaic disease (CMD) entering Nigeria (Ogbe et al. 2002). The Government of Nigeria, and Shell Petroleum Development Company of Nigeria (SPDC) consequently responded by funding the setting up of the Integrated Cassava Project (ICP). This project successfully deployed CMD resistant and high yielding cultivars and this led to increase cassava productivity. Since then subsequent cassava initiatives have made it a priority to promote CMD resistant varieties in areas that were not covered by ICP (Dixon et al. 2008). This paper presents the extent and approach of the distribution, improved varieties by UPoCA in States not covered by ICP and the farmers perception on disease mitigation and crop yields before and after their reception of the improved varieties.

Multiplication and dissemination strategy

The Project partnered with the National Root Crops Research Institute, Umudike, and farmers' associations to mobilize farmers, acquire the improved varieties

listed in Table 1, multiply them, and distribute them to farmers. The primary multiplication sites were selected based on geographical spread in the country. It was essential to minimize costs from to transportation by bringing the multiplication sites close to target zones. In 2009, the primary multipliers received the improved varieties and contract fees to produce stems. They were supervised by UPoCA personnel to ensure good plant population, and the maintenance of phytosanitary standards. Seed farms were tasked to produce about 10,000-15,000 plants/ha. The Project owned 60-90% of the stems while the farmer got all the roots and the remaining stems. In the next season, stems from these farms were harvested for widespread distribution to other farmers.

The seed farms also served as demonstration sites for the host community. All primary seed farms were georeferenced and the flow of varieties was documented. Timing of the process was season-driven and the first year of multiplication was made to tail into the planting season of the second year.

Baseline

Prior to the setting up the primary farms, a baseline survey was conducted. In Nigeria, 630 locations were surveyed during the baseline field activity. Twenty-eight enumerators and 7 supervisors were employed in this task which included the administration of questionnaire and the geo-referencing of surveyed villages and farms. Training of enumerators, field work, and data entry were concluded on 23 September 2009. Figure 1 below shows villages surveyed in each of the Project states and location of primary multiplication sites.

Ten households each from 9 villages were surveyed from three senatorial districts of each of the 7 States. Most household heads and respondents were males but 19% were female. Farming is the major profession and the age of most of the respondents (70%) was within 35-60 years. Questions pertaining to their perception of CMD and other cassava pests were administered in this survey.

Post-distribution survey

The study was carried out in seven UPoCA States of Oyo, Osun, Ondo, Ekiti, Kogi, Benue, and Nasarawa. The study was initiated in November 2010 and continued for 2 months. Sixty-two farmers selected from 80 villages were involved. Fields that were planted during a similar period were selected to minimize variation caused by different planting dates. Generally, planting took place between July and August 2009. In each farmer's field, a quadrat measuring 5m x 5m area was demarcated in two spots where observations were recorded on number of plant stands in a quadrat, total number of roots, number of rotted roots and weight of fresh roots. A short questionnaire was then administered to the farmer on issues concerning diseases and yield.

Data collected were subjected to analysis of variance using the general linear model procedure. Variety by yield related traits assessed were analyzed using a GGE biplot (Yan, 2001) Data from the questionnaire were analyzed using the frequency statistic of SPSS 17.0 (SPSS, 2010).

Results and Discussion

Baseline cassava yields from farmer's fields ranged from 1 to 15.3 t/ha in the two years before the commencement of UPoCA. The highest yield came from Benue State (Table 2). These values were estimated by the farmers. The 2010 evaluation were actual measurements (Table 3) and the farmers all agreed that the yield was much more than their previous yield.

Most respondents agreed that acreage to cassava production has increased in the past 5 years (60%),

Table 1. Released cassava varieties promoted by UPoCA in Nigeria

Year of release	Country	Variety name
Pre-2005	Nigeria	TMS 30572
2005	Nigeria	TMS 97/2205, TMS 98/0505, TMS 98/0510, TMS 98/0581 and TME 419
2006	Nigeria	TMS 92/0326, TMS 92/0057, TMS 96/1632, TMS 98/0002, and NR 87184
2008	Nigeria	TMS 96/1089A, NR 930199

Table 2. Farmer perceived cassava yields at baseline survey (t/ha).

	Improved varieties only		Local varieties only		Mixed varieties		All varieties	
State	Yr 2008/09	Yr 2007/08	Yr 2008/09	Yr 2007/08	Yr 2008/09	Yr 2007/08	Yr 2008/09	Yr 2007/08
Benue	15.30	11.81	14.32	11.82	13.20	11.66	14.27	11.76
Ekiti	0.04	0.03	9.97	9.97	0.00	0.00	3.34	3.33
Kogi	0.37	0.21	1.24	0.50	4.29	2.58	1.97	1.09
Nasarawa	9.10	9.23	4.27	4.16	7.89	16.78	7.09	10.06
Ondo	6.94	7.57	0.63	0.55	9.16	9.30	5.58	5.81
Osun	8.69	8.76	6.47	5.97	9.89	10.45	8.35	8.39
Oyo	1.21	1.81	2.78	3.74	1.02	1.37	1.67	2.31

Table 3. Root yield (t/ha) and rotted roots (%) from improved cassava varieties grown by farmers in the seven states in 2010.

State	Fresh root yield (t/ha)	Rotted roots (%)
Benue	16.3	4.5
Ekiti	9.9	4.4
Kogi	18.1	14.1
Nasarawa	20.8	0.3
Ondo	10.6	3.5
Osun	14.7	10.1
Oyo	24.0	15.5
Mean	16.3	7.5
SE	1.9	2.2

14% felt there has not been any change. While 82% of the farmers agreed to gradually replace their local varieties with these improved varieties, 18% were undecided.

Eighty-seven percent of the farmers responded that they are aware of CMD as a problem at baseline and all the farmers evaluated in 2010 did not observe CMD. They however reported incidence of cassava bacterial blight and root rot. They also reported losses from grasscutters or cane rats (*Thryonomys swinderianus*) to TME 419.

During the baseline survey, farmers were asked to indicate if the characteristics listed in Table 5 were important for their consideration of a variety for adoption. The results from all the States showed that all characteristics were important. In terms of ranking, fresh root yield was most important and dry matter the least. This is probably because the price they receive from sale of roots is measured by weight which includes the water content of the cassava. Consequently, the bigger the root, the more money they make. Dry matter content would be probably most appreciated by the cassava processors.

While market price, market demand, and maturity period rank as highly important to the farmers, the cyanide content of the varieties and the period of underground storage after maturity were not so important. The low ranking of period of underground storage could indicate why the farmers lost about 4.5 to 15.5%of their root yield to rot. Okechukwu et al. (2008), and Okechukwu and Dixon (2009)

Table 4. Cassava pests experienced by farmers in their farms.

	State							
Response	Benue	Ekiti	Kogi	Nasarawa	Ondo	Osun	Oyo	Total
CMD	100.0	100.0	100.0	100.0	100.0	75.0	29.4	87.4
Grasscutter	0.0	0.0	0.0	0.0	0.0	2.8	11.8	1.8
Grasshopper	0.0	0.0	0.0	0.0	0.0	0.0	35.3	3.6
Termite	0.0	0.0	0.0	0.0	0.0	22.2	11.8	6.0
Tuber rotting	0.0	0.0	0.0	0.0	0.0	0.0	11.8	1.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5. Important characteristics farmers consider when choosing cassava varieties to grow.

	State								Ranked
	Benue	Ekiti	Kogi	Nasarawa	Ondo	Osun	Oyo	Total	1st
Dry matter content									
No	71.1	76.7	7.9	12.2	69.5	17.8	41.3	42.1	
Yes	28.9	23.3	92.1	87.8	30.5	82.2	58.8	57.9	17.3
Root yield									
No	15.6	18.0	20.7	31.1	37.8	67.1	53.1	34.4	
Yes	84.4	82.0	79.3	68.9	62.2	32.9	46.9	65.6	96.7
Maturity period									
No	27.3	27.0	13.4	31.1	51.1	54.8	61.2	38.0	
Yes	72.7	73.0	86.6	68.9	48.9	45.2	38.8	62.0	95.9
Disease resistance									
No	67.9	29.5	41.0	41.1	50.6	19.7	83.0	45.7	
Yes	32.1	70.5	59.0	58.9	49.4	80.3	17.0	54.3	72.9
Perceived cyanide									
No	81.8	70.5	49.2	47.2	49.4	79.5	72.4	63.0	
Yes	18.2	29.5	50.8	52.8	50.6	20.5	27.6	37.0	45.6
Market price									
No	37.1	39.8	14.8	42.2	39.3	65.0	62.8	43.0	
Yes	62.9	60.2	85.2	57.8	60.7	35.0	37.2	57.0	94.1
Market demand									
No	57.5	43.8	19.8	43.3	41.1	63.1	64.1	47.4	
Yes	42.5	56.2	80.2	56.7	58.9	36.9	35.9	52.6	90.6
Period of underground storage after maturity									
No	76.2	62.5	42.5	44.4	55.6	61.9	71.8	58.9	
Yes	23.8	37.5	57.5	55.6	44.4	38.1	28.2	41.1	84.1

Table 6. Varietal mean performance for number of plants, total fresh roots, fresh root yield (t/ha), and rotted roots (%) for 13 improved cassava varieties grown in farmers' fields in 2010.

Variety	No. of plants	Total fresh roots	Fresh root yield (t/ha)	Rotted roots (%)
92/0326	20.3	108.7	10.4	37.1
M98/0068	25.0	143.0	14.2	35.1
98/0581	25.5	111.8	16.5	23.5
TMS30572	16.7	103.8	16.6	1.0
98/0510	15.2	77.5	17.3	29.2
96/1632	25.4	114.8	17.7	26.5
98/0505	22.8	99.3	18.2	26.6
TME419	21.0	117.0	19.9	10.8
95/0289	21.8	96.0	20.0	19.2
91/02324	20.4	119.4	20.7	13.0
NADP	30.0	160.8	20.9	0.4
92/0057	25.0	132.5	24.9	14.0
97/2205	35.0	161.0	35.1	0.0

have reported that there is no variety absolutely resistant to root rot among these released varieties and that early harvest (9–11 months after planting) is still the best way to reduce losses. Root rot also significantly ($P \leq 0.05$) influenced by genotype and environment interaction. Most root rot is recorded in the humid forest and the least is in the Sudan savanna agroecological zone. This is true in this case also, as more rots were recorded in Oyo, Osun, and Kogi States (which are closer to the humid forest of Nigeria) unlike in Nasarawa State (savanna zone).

Across all the states, 97/2205 had the highest yield (35.6 t/ha) while 92/0326 had the least yield. Figure 2 shows that 92/0326 was mostly susceptible to root rot. TMS30572 and NADP had also low levels of root rot recorded. These are old improved varieties that have been in circulation for over 35 years in Nigeria.

Conclusion

To date, UPoCA has achieved over 145ha of seed farms and has provided over 15,000 farmers with improved varieties. By 2011, it is hoped that the propagation of improved varieties, backed by farmer training in integrated cassava crop management, will lead to on-farm yields at least 30% greater than those with existing traditional varieties. Much work is still required to tackle postharvest problems such as the early deterioration of cassava after harvest and rot due to underground storage for over 15 months. In the interim, extension service support to farmers should teach that to reap the real yield from improved varieties currently being spread in Nigeria early harvest, not up to 15 months, should be practiced.

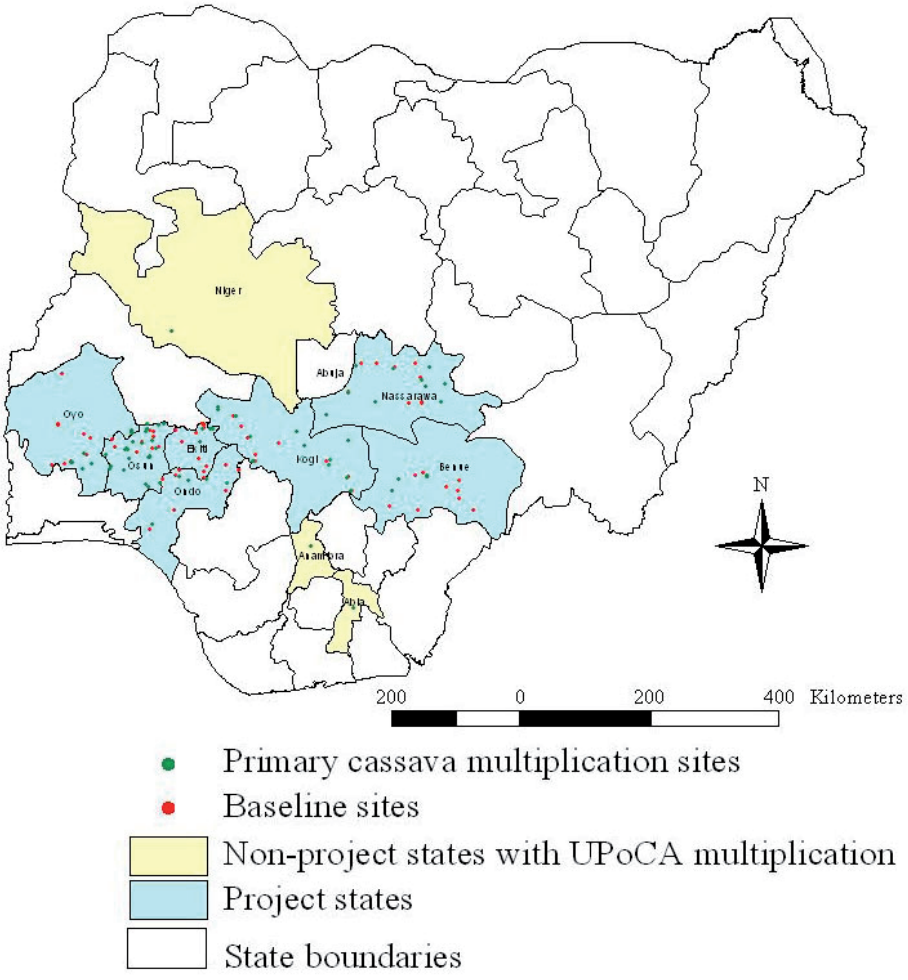

Figure 1. Villages surveyed for baseline information and cassava multiplication sites.

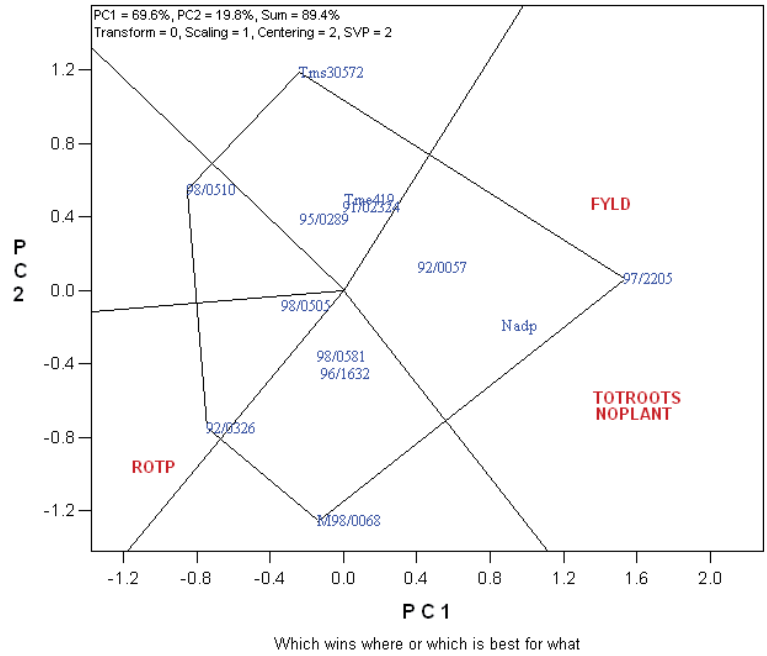

Figure 2. GGE Biplot analysis of 13 improved varieties and their association with yield related traits assessed in 2010 from farmers' fields.

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