Increasing smallholder cassava yields

Participatory testing of improved cassava varieties in heterogeneous environments in southern Cameroon

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1.Introduction

Agriculture in the humid forest of southern Cameroon is still largely based on traditional low in-put slash and burn systems. Cassava is the staple food in this area. The demand for cassava derived products, especially in urban area's, has been growing rapidly. Due to a combination management, biotic and abiotic production constraints yields are generally low. IITA has developed high yielding varieties capable of increasing production above subsistence levels and improving rural cash income. A set of on-farm trials was carried out to (i) explore production constraints for cassava and (ii) assess the potential of a best-bet IITA variety to increase production levels.

2.Materials and methods

In March 2007 in the periphery of Yaoundé (rainfall: 1530 mm, bimodal) two locations with contrasting land use intensity (LUI) and subsequent soil properties (table1) were selected for the purpose of this study. In a total of 25 trial sites (2-4 year-old fallows) a variety trial was established with one best performing local variety and a an IITA variety (96/1414). Soil samples were taken to evaluate soil fertility conditions. Overall weed management throughout the growing season was scored from 1 (very poor) to 5 (very good). Disease severity over time was visually scored (range of 0-4) every 3 months and analyzed using an adapted area under severity index progress curve (AUSiPC). At harvest 12 months after planting (MAP) yield components were evaluated together with farmers (Fig. 2).

Fig. 1: Picture of trial site with left the local CMD susceptible variety and left the improved CMD resistant variety (IITA 96/1414)

Fig. 2: Picture of participatory harvesting and yield evaluation

3. Results

A. Differences of soil properties between sites

Soil properties varied strongly between individual fields (Table 1). Generally soils characterized as acid Ultisols, were more sandy and had lower total N and SOC content in the high LUI location. In 88% of fields at least one of soil fertility parameters was below critical levels identified for cassava[1], with low SOC being the most frequently found limiting factor (76% of fields). Fields with P, K or multiple limitations for cassava were more frequent in the high LUI area.

Table 1: soil properties (0-10cm) and weed management score (WM) of the trial locations with different land use intensities (LUI)

Land use intensity (LUI)		Particle size (%)			pH water	SOC	TotalN	CNratio	P	Exch. bases (cmol+ kg-1)			WM
		Sand	Silt	Clay	(1:2.5)	(g kg-1)	(g kg-1)		(mg kg-1)	K	Ca	Mg	
Low LUI	Mean	57	35	8	5.2	16.3	1.7	9.8	11.4	0.26	2.3	1.1	4.38
(n=13)	Min	43	21	0.4	4.0	14.1	1.4	8.7	4.5	0.11	0.35	0.48	
	Max	67	43	16	6.2	20.3	2	11.3	33.2	1.1	7.4	1.8	
High LUI	Mean	66	30	4	5.3	16.1	1.4	11.4	6.4	0.26	2.9	1.36	3.25
(n=12)	Min	47	21	1	4.5	9.2	0.9	9.8	2.9	0.07	0.73	0.31	
	Max	77	51	9	6.2	23.3	2.1	13.6	17.0	0.64	6.7	3.0	
	p-level	*0.01*	*0.1*	*0.05*	*ns*	*ns*	*0.05*	*0.001*	*ns*	*ns*	*ns*	*ns*	*0.01*

B. Effect of location and variety on yield components

Overall cassava yields averaged 10,0 ton ha^{-1}. This is low in comparison to yields attained under on-station breeding trials (30 t ha^{-1}). Yields were 86% higher in the low LUI location compared to the high LUI location (Fig. 3) due to better soil fertility conditions, higher plant density at harvest, higher HI, higher DM content of roots, better weed management, and less root rot (Table 1 and 2). The improved variety had almost 50% higher yields in both locations (Fig. 2) and was characterized by a higher HI and dry matter content and more marketable roots (Table 2). Yield of improved variety was significantly lower in the high LUI.

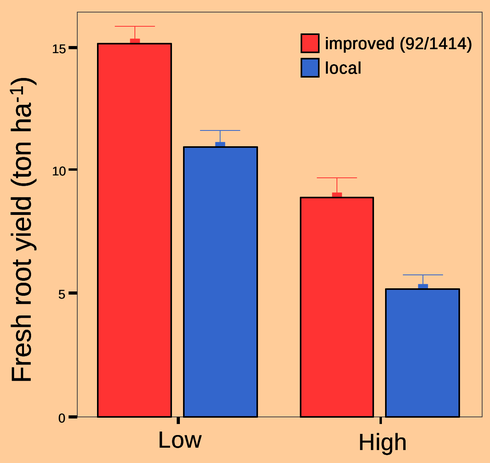

Fig. 3: Fresh cassava root yields of both a local and an IITA improved variety in a location with low and a high land use intensity (LUI). Error bars indicate SE.

Table 2: Effect of location and variety on some yield components and disease severity

		n	Yield	Plant density at harvest	Above-gr. biomass	HI fresh	Mrktble roots	Dry matter roots	Adapted AUSiPC			Root rot
	Variety		t ha-1	`000 ha-1	t ha-1		%	%	CMD	CBB	CAD	%
low LUI	improved	65	15.2	8.4	20.1	0.41	86	30.4	3.3	7.1	4.2	6.9
	local	65	10.9	8.6	18.1	0.35	82	35.6	25.7	8.3	7.2	7.5
	p level		*<0.001*	*ns*	*ns*	*<0.001*	*0.01*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*ns*
high LUI	improved	57	8.89	7.0	15.6	0.33	71	28.2	4.6	6.2	4.5	27.1
	local	57	5.19	6.7	11.6	0.28	69	33.2	24.3	14.5	10.4	12.0
	p level		*<0.001*	*ns*	*0.05*	*<0.001*	*0.01*	*<0.001*	*<0.001*	*0.01*	*<0.001*	*ns*
	Anova significances for the effects of:											
	Location (L)		*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*0.001*	*ns*	*<0.001*	*<0.001*	*<0.001*
	Variety (V)		*<0.001*	*ns*	*0.01*	*<0.001*	*0.05*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*0.001*
	V x L		*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*0.01*	*<0.001*	*<0.001*	*0.001*

C. Weed management

Average root yields were positively related to weed management scores (r=0.52, P<0.001). Maximum yields obtained under weed management score 1 was 5.4 t ha^{-1}, while with good weed management maximum yields were 19.6 t ha^{-1} (Fig. 4).

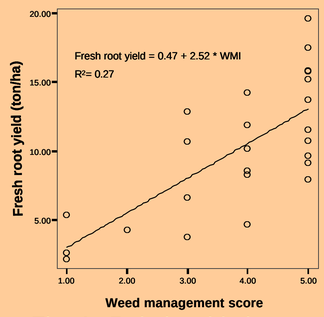

Fig. 4: Relationship between fresh root yield and level of weed management score per field.

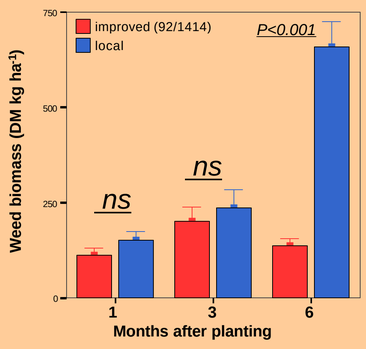

Fig. 5: Weed dry matter of some selected fields. Error bars indicate SE.

Weed pressure under the improved variety was significantly lower at 6 MAP than under local varieties (Fig. 5). Total above-ground biomass at harvest was higher for the improved than for the local varieties (Table 2). This may be related to the lower CMD pressure in the improved variety (Table 2) as this caused severe defoliation in the local susceptible variety (Fig. 1). The improved variety thus shades out weeds more effectively than local varieties.

D. Disease incidence

A lower incidence of cassava mosaic disease (CMD), cassava bacterial blight (CBB) and cassava anthracnose disease (CAD) were recorded for the improved variety (Fig. 6). In general higher disease scores were recorded in the high LUI location except for root rot (Table 2).

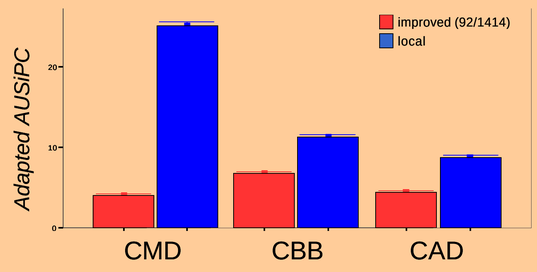

Fig. 6: Disease incidence in two cassava varieties indicated as adapted area under severity progress curve (AUSiPC) with range 0-42. Error bars indicate SE.

4. Conclusion

A combination of low soil fertility, high incidence of multiple diseases and poor weed control can be considered as main constraints to cassava production in the humid forest zone of Cameroon. Improved varieties showed good potential to increase cassava yields. The better performance of the improved variety can be attributed to a combination more marketable roots, a lower susceptibility to diseases, and consequently more foliage and lower weed pressure. The use of improved varieties and efficient weed control, should be promoted to improve yields and revenue potential for farmers in Cameroon.

[1] (SOC-18g kg^{-1}; K-0.18 cmol$_+$ kg^{-1} ;P-8 mg kg^{-1}) (Howeler, 2002)