Relationship between root and shoot growth traits during the plant crop and first ratoon in banana and plantain (*Musa* spp.) and its implications for perennial cultivation on degraded Ultisols in south-eastern Nigeria.

G. Blomme[1], R. Swennen[2], G. E. Soka[3], F. L. Turyagyenda[3] and A. Tenkouano[4]

[1]International Institute of Tropical Agriculture (IITA), High Rainfall Station, P.O.Box 008 Nchia-Eleme, Rivers State, Nigeria. Present address: Bioversity International, Uganda office, P.O.Box 24384, Kampala, Uganda, G.Blomme@CGIAR.org;
[2]Laboratory of Tropical Crop Improvement, Department of Biosystems, Katholieke Universiteit Leuven (K.U.Leuven), Kasteelpark Arenberg 13, 3001 Leuven, Belgium, Rony.Swennen@biw.kuleuven.be;
[3]Bioversity International, Uganda office, P.O. Box 24384, Kampala, Uganda, G.Soka@inibap.co.ug, and f.turyagyenda@cgiar.0rg;
[4]Humid Forest Eco-regional Center (Yaoundé), International Institute of Tropical Agriculture, BP 2008 Messa, Yaoundé, Cameroon, A.Tenkouano@CGIAR.ORG

Abstract:

The effect of cycle on root system and shoot development was studied for two crop cycles (plant crop and first ratoon). The study revealed that shoot and root system development declined from the plant crop to the first ratoon for plants grown on degraded Ultisols in south-eastern Nigeria.

Introduction

The few root studies conducted so far in *Musa* are mainly devoted to observations during the first months of the first cycle. Therefore, studies are needed of the root system during the second cycle when all plant components are in place (i.e. the remains of the plant crop, first ratoon and the sucker which will produce the second ratoon). Hence, the objective of this study was therefore to evaluate root system and shoot development during the plant crop and first ratoon crop of several *Musa* spp. genotypes.

Materials and methods

Trial site:

Location: Onne High Rainfall station (4°42' N, 7°10' E, 5 m asl) in southeastern Nigeria

Soil: Typic Paleudult/ Haplic Acrisol (FAO)

Annual rainfall: 2,400 mm distributed monomodally from March until November

Type of planting material used: Micropropagated plants were transplanted to the field six weeks after acclimatization. Plants were grown under monocropping conditions.

Genotypes assessed (see Table 1)

Planting date: 10 October 1996

Evaluation dates: at flower emergence and at harvest of both the plant crop and the subsequent first ratoon crop. Four plants per genotype were assessed at each growth stage.

The field layout: completely randomized design

Agronomic practices: standard field management practices were carried out

Parameters assessed: All plants were completely excavated and aerial, corm and root characteristics were measured

Statistical Analysis: The statistical analysis was carried out using the SAS statistical package (Version 8) (SAS, 1989).

Table 1. Name, genome, ploidy level, type and suckering behaviour of the genotypes evaluated

Name	Genome	Ploidy level	Type	Suckering behaviour
Calcutta 4	AA	2	Wild diploid	Non-regulated
Valery	AAA	3	Dessert banana	Regulated
TMPx 548-9	AAB x AA	4	Plantain hybrid (Obino l'Ewai x Calcutta 4)	Regulated
TMPx 1621-1	AAB x AA	4	Plantain hybrid (Obino l'Ewai x Calcutta 4)	Regulated
TMPx 5511-2	AAB x AA	4	Plantain hybrid (Obino l'Ewai x Calcutta 4)	Inhibited

High mat phenomenon

Table 2. Plant growth characteristics at flower emergence (FL) and harvest (H) of the plant crop and the first ratoon crop (mean values and s.e. for the five genotypes combined)

	Plant crop			First ratoon		
Trait#	FL	H	% (1)	FL	H	%
LA	65,801±4,579	8,161±2,368	-88	61,166±3,114	7,025±3,019	-89
NL	10.5±0.5	1.9±0.4	-82	9.9±0.4	1.5±0.5	-85
PH	195±9	196±11	1	215±8	201±13	-7
PC	55±2	47±3	-15	54±2	46±2	-15
NS	16±1	16±1	0	12±1	13±1	8
HS	120±10	158±12	32	68±11	93±12	37
CW	3,836±380	3,067±302	-20	4,760±426	4,131±565	-13
CH	24±1	23±1	-4	28±1	28±1	0
WW	16±1	15±1	-6	18±1	17±1	-6
DR	130±12	111±13	-15	146±13	90±8	-38
NR	134±11	123±7	-8	149±8	131±11	-12
LR	3,778±355	2,268±192	-40	3,003±333	1,841±121	-39
AD	4.9±0.2	5.2±0.2	6	5.5±0.2	5.5±0.2	0
TD	274±28	409±37	49	336±38	26035	-23
TL	7,699±783	9,677±1,619	26	7,327±1,309	5,665±959	-23
%suckerDR	50±2	69±4	na	51±4	54±6	na
%suckerLR	49±2	68±3	na	52±4	57±5	na

#: LA: leaf area (cm^2), NL: number of leaves, PH: plant height (cm), PC: pseudostem circumference (cm), NS: number of suckers, HS: height of the tallest sucker (cm), CW: corm weight (g), CH: corm height (cm); WW: corm widest width (cm), DR: root dry weight (g), NR: number of cord roots, LR: cord root length (cm), AD: average basal cord root diameter (mm), TD: total root dry weight of the mat (g), TL: total length of the cord roots of the mat (cm), %suckerDR: percentage root dry weight of the suckers to the mat (i.e. plant crop and suckers), %suckerLR: percentage cord root length of the suckers to the mat (1): percentage difference between harvest and flower emergence na: non applicable

Results and discussion

This study shows the reduction in leaf area, corm weight and root system traits during the reproductive stage of both the plant crop and the first ratoon cycle (Table 2). First ratoon plants were slightly taller than the plant crop, had a bigger corm resulting in a higher number of cord roots. However, cord root length was reduced for the first ratoon crop. In addition, there was a reduction in sucker vigour during the ratoon crop, which may be attributed to the observed high mat phenomenon and possible soil degradation. This poor sucker growth will negatively influence plant anchorage and stability and demonstrates the limited possibilities of degraded ultisols for production of consecutive ratoon crops under monocropping conditions.

References

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