Tree and Forestry Science and Biotechnology ©2010 Global Science Books

The Effect of Application of Organic Matter during Planting on Growth of an East African Highland Cooking Banana Grown on Two Contrasting Soils in South Kivu, Eastern DR-Congo

Jules Ntamwira[1] • Dowiya Benjamin Nzawele[1] • Dieudonné Katunga[1] • Piet Van Asten[2] • Guy Blomme[3*]

[1] INERA, Mulungu research station, Bukavu, South Kivu, DR-Congo
[2] International Institute for Tropical Agriculture, P. O. Box 7878, Kampala, Uganda
[3] Bioversity International, Uganda office, P. O. Box 24384, Kampala, Uganda

Corresponding author: * G.BLOMME@CGIAR.ORG

ABSTRACT

Highland bananas grown near the homestead in Eastern Democratic Republic of Congo receive organic household residues and are often mulched. Farmers also tend to allocate their best land for banana cultivation. However, due to an increased demand for bananas, farmers have started establishing banana plots on less fertile land. An experiment was conducted to assess plant growth on plots further away from the homestead and with minimal amounts of organic matter input. Two sites with contrasting soil fertility were chosen. Soil samples taken at the onset of the trial were analysed. The organic matter input consisted of *Loudetia* sp., the dominant weed species found on marginal soils, while *Tithonia diversifolia* was added to facilitate the decomposition of *Loudetia* sp. Pared lateral shoots of the east African highland cooking banana 'Barhabesha' (AAA-EA) were planted. The treatments consisted of 2 kg of organic matter added in the planting hole at planting, 2 kg of organic matter applied as mulch around the plant after planting, 1 kg of organic matter applied in the panting hole during planting and 1 kg of organic matter applied as mulch on the soil after planting. No organic matter was applied in the control. The following growth characteristics were assessed at 12 months after planting: plant height, total number of leaves formed and pseudostem circumference at the base of the plant. There was enhanced plant growth in the more fertile soil at Mulungu. Plant growth was enhanced with application of organic matter. Although this effect was more pronounced in the poor soil of Cijingiri, plant performance was generally so poor at this location that bananas cannot be considered a viable enterprise in such degraded soils.

Keywords: *Loudetia* sp., *Tithonia diversifolia*

INTRODUCTION

Bananas and plantains are the staple food for over 20 million people in the great lakes region of central and eastern Africa. Bananas and plantains are the second most important staple food crop after cassava in the Democratic Republic of Congo (Musaco 2004). The constraints threatening banana and plantain production in eastern DR-Congo include poor soil fertility, pest and diseases, and socio-economic constraints such as access to inputs. Highland bananas are often grown near the homestead in Eastern Democratic Republic of Congo. These plots receive substantial amounts of organic household residues and are often mulched (Van Asten *et al*. 2004). Farmers often allocate their best land for banana cultivation. However, farmers have started establishing banana plots on less fertile land due to an increased population pressure and a high demand for bananas.

Nutrients can be imported in a plot/field through inorganic or organic (e.g. mulch, manure) fertilizers (Swennen 1990). Soil organic matter is essential for long term high production levels in banana plantations. Soil organic matter enhances root growth and thus nutrient and water uptake through improved soil porosity, and water infiltration (Swennen 1990). However, competition of organic inputs (e.g. mulch) is high and application is labor intensive.

There was an interest to study how small organic inputs that are locally available to farmers can be managed optimally for improved plant performance in newly established plantations. Depending on the overriding abiotic constraint (i.e. nutrient and water stress), incorporation or surface application of mulch will have different impacts on plant performance on different soil types. An experiment was conducted to assess banana plant growth in plots further away from the homestead with small amounts of organic matter applied in different ways to newly established plants.

MATERIALS AND METHODS

Two sites with contrasting soil fertility were chosen. The trials were established at the Institut National pour l'Etude et la Recherche Agronomiques (INERA) Mulungu research station and at Cijingiri. Mulungu is located at 02°20.042′ S and 028°47.311′ E at an altitude of 1,707 meters above sea level (masl), while Cijingiri is located at 02°42.189′ S and 028°51.721′ E at an altitude of 1,602 masl. The soil at Mulungu is fertile, while Cijingiri has very poor soils. Soil samples taken at the onset of the trial were analysed following Okalebo *et al*. (1993). The organic matter input consisted of *Loudetia arundinacea* and *Loudetia simplex* (Graminae), the dominant weed species found on marginal soils, while *Tithonia diversifolia* (Asteraceae) was added to facilitate the decomposition of *Loudetia*. Pared lateral shoots of the east African highland cooking banana 'Barhabesha' (AAA-EA) were planted.

At each location there were 2 replications of 12 plants per treatment. A total of 96 plants were thus planted at each location. Plant spacing was 3 × 2 m. The planting holes measured 60 × 60 × 60 cm. Weeding was carried out at monthly intervals, while contour bunds were also established.

The treatments consisted of: (T1) 1 kg dry organic matter applied in the planting hole at planting and 1 kg of dry organic matter applied as mulch on the soil after planting, (T2) 2 kg of dry organic matter applied as mulch around the plant after planting and

Received: 4 February, 2009. Accepted: 5 April, 2010.

Short Communication

Table 1 Plant height, pseudostem circumference at soil level and number of leaves formed at 3, 6 and 12 months after planting (MAP).

Treatment		Plant height (cm)			Pseudostem circumference at soil level (cm)			Number of leaves		
		3 MAP	6 MAP	12 MAP	3 MAP	6 MAP	12 MAP	3 MAP	6 MAP	12 MAP
Mulungu	T0 (Control)	69 a[#]	73 a	171 a	6.6 a	7.4 a	52 a	5.9 b	7.3 a	27 a
	T1	78 a	86 a	240 b	5.9 a	8.0 a	68 b	5.1 a	7.3 a	30 b
	T2	75 a	76 a	185 a	5.8 a	7.6 a	54 a	4.7 a	7.5 a	28 a
	T3	78 a	81 a	181 a	6.7 a	8.0 a	53 a	5.7 b	7.5 a	29 b
	LSD	13.8	12.6	19	1.1	1.09	4	0.8	0.71	1.7
	CV	32	28	17	32	24.6	14	10	16.8	10
Cijingiri	T0 (Control)	42 b	43 b	77 c	3.8 c	4.6 b	27 c	4.5 a	5.8 b	25 c
	T1	51 c	58 c	104 d	4.5 d	6.2 c	33 d	5.3 b	6.8 a	27 d
	T2	62 d	59 c	108 d	4.6 d	6.2 c	33 d	5.3 b	6.7 a	27 d
	T3	59 c	56 c	99 d	4.6 d	6.6 c	34 d	5.6 b	6.8 a	27 d
	LSD	8.3	6.49	12	0.6	0.9	3	0.5	0.66	1.2
	CV	38	30	17	33	38	23	25	25	11

#: Values followed by the same letter in a column are not significantly different at $p< 0.05$ according to Tukey's studentised range Test.
*(T1) 1 kg dry organic matter applied in the panting hole at planting and 1 kg of dry organic matter applied as mulch on the soil after planting, (T2) 2 kg of dry organic matter applied as mulch around the plant after planting and (T3) 2 kg of dry organic matter added in the planting hole during planting. No organic matter was applied in the control (T0).

Table 2 Soil characteristics of the two sites.

Site	pH	OM (%)	N (%)	P (ppm)	K ($cmol_c$/kg)	Ca ($cmol_c$/kg)	Mg ($cmol_c$/kg)
Cijingiri	4.43	3.0	0.17	2.7	0.15	0.14	0.06
Mulungu	6.50	7.3	0.33	139.8	2.48	12.12	2.92

(T3) 2 kg of dry organic matter added in the planting hole during planting. No organic matter was applied in the control (T0). The 2 kg of organic matter per plant consisted of a mixture of 1 kg of *T. diversifolia* and 1 kg of *Loudetia*. The applied quantity of organic matter was derived through surveys conducted in the region on the quantity of organic matter applied per banana plant (unpublished).

The following growth characteristics were assessed at 3, 6 and 12 months after planting: plant height (cm), total number of leaves formed and pseudostem circumference at the base of the plant (cm). Plant height was measured from soil level to the point where the youngest 2 leaf petioles join. Old and senescent leaves were continuously removed and de-suckering was practiced.

The data were analysed using the GenStat for Windows statistical package (GenStat 2003). Tukey's studentised range Test was used to determine significant differences (at 5% probability level).

RESULTS AND DISCUSSION

There was an enhanced plant growth in the more fertile soil at Mulungu compared to Cijingiri (**Table 1**). Plant height at Mulungu at 12 month after planting was at least 171 cm, while plants at Cijingiri had not grown taller than 108 cm. Application of organic matter increased plant growth (i.e. height, circumference, number of leaves) at both sites, although in Mulungu this effect was only significant for all plant growth parameters of 12 months old plants when the application was split over planting hole and surface application.

As mentioned in the introduction, it was hypothesized that surface application or application into the planting hole would generate different responses depending on water stress (i.e. surface application may be preferred) or nutrient stress (i.e. application in planting hole may be preferred). The fact that the mixed planting hole – surface application performed best in Mulungu may indicate that there is a positive interaction between water availability and plant nutrient uptake. In Cijingiri, the positive effect of organic matter applications was largely independent of the mode of application. This suggests that the primary constraints are most likely cation deficiencies. The poor soils of Cijingiri are not recommended for banana cultivation, since they are acid and have very low plant available P and K contents (**Table 2**). Banana plants can support a soil pH of 4 to 8, but a pH of 6 to 7.5 is recommended (Anonymous 1993). The plant height achieved after 12 months predicts a very poor bunch weight and long crop cycle duration. Swennen and De Langhe (1985) also reported that a high yield is determined by vigorous initial growth of the planted sucker. It will hence be very difficult for the farmer to get acceptable returns to his investments (i.e. labor, planting material, organic matter inputs).

The results indicate that small applications of organic matter can have a positive impact on plant performance. Further research on the most cost-effective quantity and quality is however needed for optimum banana production in soils with contrasting fertility levels.

ACKNOWLEDGEMENTS

We are grateful for the financial support from the Belgian Directorate General for Development Cooperation (DGDC) through the Consortium for Improving Agriculture-based livelihoods in Central Africa (CIALCA).

REFERENCES

Anonymous (1993) *Mémento de l'Agronome* (4th Edn), République Française. Ministère de la Coopération. Collection Techniques Rurales en Afrique, 806 pp

GenStat (2003) GenStat statistical package for Windows. Lawes Agricultural Trust, Rothamsted Experimental Station, UK

MUSACO (2004) Rapport de la sixième réunion du comité du pilotage. Multiplication rapide et distribution de matérielle de plantation de variétés améliorée et productive de bananier chez le planteur de la province du Bas Congo, 33 pp

Okalebo JR, Gathua KW, Woomer PL (1993) *Laboratory Methods of Soil and Plant Analysis: A Working Manual*, TSBF, EPZ Printers, Nairobi, Kenya, 88 pp

Swennen R, De Langhe E (1985) Growth parameters of yield of plantain (*Musa* cv. AAB). *Annals of Botany* **56**, 197-204

Swennen R (1990) *Plantain Cultivation under West African Conditions*, International Institute of Tropical Agriculture, Ibadan, Nigeria, 16 pp

Van Asten PJA, Gold CS, Okech SH, Gaidashova SV, Tushemereirwe W, De Waele D (2004) Soil quality problems in East African banana systems and their relation with other yield loss factors. *InfoMusa* **13 (2)**, 20