Data in Brief 31 (2020) 105890

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

A dataset on above- and below-ground traits of 21 species found in banana cropping systems, cultivated individually

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ARTICLE INFO

Article history:
Received 19 April 2020
Revised 11 June 2020
Accepted 11 June 2020
Available online 20 June 2020

Keywords:
Cover crops
Leaf traits
Plant traits
Root traits
Light acquisition
Nutrient acquisition
Banana
Weeds

ABSTRACT

The data presented in this article describe 21 species that can be found in banana cropping systems: 17 cover crops species, 2 spontaneous species and 2 cultivars of banana. The cover crop species belongs mainly to Fabaceae family, but also to Poaceae, Euphorbiacea and Asteraceae. Four repetition of each species were cultivated individually, in the field, under non-limiting conditions. 40 variables were measured on whole plant, leaves and roots, at flowering or after six months of growth for longer cycle species. This dataset is made available to provide data on these species, enable comparisons between datasets and meta-analysis on cover crop or on species presented in arable fields. The data presented in this article were used in the research articles entitled "Trait-based characterisation of cover plants' light competition strategies for weed control in banana cropping systems in the French West Indies" (Tardy et al. 2015) and "Trait-based characterization of soil exploitation strategies of banana, weeds and cover plant species" (Tardy et al. 2017).

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https://doi.org/10.1016/j.dib.2020.105890

Specifications Table

Subject	Agricultural and Biological Sciences (General)
Specific subject area:	Description of aboveground and underground traits related to competition for resources of 17 cover crops, 2 spontaneous species and 2 cultivars of banana.
Type of data:	Table
How data were acquired:	Field measures of plants grown individually in the field. Instruments and methods: Scanner and WinRhizo Pro-analytical software (Regent Instruments) for leaf and root measurements 10 cm × 10 cm mesh grid positionned on vertical soil profiles for root impacts observations CHN analyser (Elementar Vario Macro Cube) and Dumas method for leaf total N quantification
Data format:	Raw analysed
Parameters for data collection:	Type of soil: andosols Irrigation: rain-fed regime, cumulated annual precipitation 2829 mm Fertilisation: 50 g of urea (46% N) applied at the base of each plant at the beginning of the experiment. Temperature: 25.6 °C averaged over the experiment, ranging from 22.8 °C to 29.7 °C. Plants were grown individually, in the field, in separated 16 m^2 plots.
Description of data collection:	The data were collected on each plants (4 per species/cultivars) at flowering for short cycle species, and after ~6.5 months of growth for longer cycles or perennial plants. Well-exposed leaves were separated to determine some traits according to standardized protocols in ecology (SLA, LDMC, LNC). The rest of the plants were separated into stems, petioles and leaf blades and weighted. A 1-m deep and 1-m wide trench that was dug 20 cm from the base of each plant. The root intersections in the vertical soil profile were counted on a 5 cm × 5 cm mesh grid. For each plant, three cubes of 1000 cm^3 of soil samples were removed at different positions in the root system.
Data source location:	City/Town/Region: Experimental station of Neufchateau, Capesterre Belle Eau Country: Guadeloupe, French West Indies Latitude and longitude (and GPS coordinates) for collected samples/data: 16°05′N, 61°35′W
Data accessibility:	Repository name: Cirad Dataverse Data identification number: / Direct URL to data: doi:10.18167/DVN1/HIEXNF
Related research article:	Tardy F., Damour G., Dorel M., Moreau D. 2017. Trait-based characterization of soil exploitation strategies of banana, weeds and cover plant species. PlosOne, 12(3): e0173066. http://dx.doi.org/10.1371/journal.pone.0173066 Tardy F., Moreau D., Dorel M., Damour G. 2015. Trait-based characterisation of cover plants' light competition strategies for weed control in banana cropping systems in the French West Indies. European Journal of Agronomy, 71: 10–18. http://dx.doi.org/10.1016/j.eja.2015.08.002

Value of the Data

- The data represent leaf, root and plant trait values of 21 species that can be found in banana cropping systems: 17 cover crops species, 2 spontaneous species and 2 cultivars of banana. They could be used by other researchers who need data on these species/varieties.
- The data enable other researchers to compare their own data with this dataset and to extent their analysis.
- These data could be used in meta-analysis on cover crops or on species present in arable fields.

Data description

The dataset presented in this article (doi:10.18167/DVN1/HIEXNF) is composed of 40 variables measured on 17 species of cover crops, 2 spontaneous species widely present in banana agrosys-

Table 1
List of the species/cultivars included in the dataset.

Abbreviation	*Full names*	Taxonomic group	Family	Type
AP	*Arachis pintoi*	dicot	Fabaceae	cover crop
B925	*Musa* SPP., *AAA group*, VAR. *Cirad 925*	monocot	Musaceae	banana
Bcav	*Musa* SPP., *AAA group*, VAR. *Cavendish*	monocot	Musaceae	banana
BD	*Brachiaria decumbens*	monocot	Poaceae	cover crop
BP	*Bidens pilosa*	dicot	Asteraceae	spontaneous
BR	*Brachiaria ruziziensis*	monocot	Poaceae	cover crop
CCG	*Cajanus cajan* VAR. *Guadeloupe*	dicot	Fabaceae	cover crop
CP	*Centrosema pascuorum*	dicot	Fabaceae	cover crop
CS	*Crotalaria spectabilis*	dicot	Fabaceae	cover crop
CZ	*Crotalaria zanzibarica*	dicot	Fabaceae	cover crop
DL	*Dolichos lablab*	dicot	Fabaceae	cover crop
GS	*Gliricidia sepium*	dicot	Fabaceae	cover crop
MD	*Mucana deeringiana*	dicot	Fabaceae	cover crop
N	*Vigna unguiculata* VAR. *David*	dicot	Fabaceae	cover crop
NW	*Neonotonia wightii*	dicot	Fabaceae	cover crop
M	*Momordica charantia*	dicot	Cucurbitacea	spontaneous
PN	*Paspalum notatum*	monocot	Poaceae	cover crop
PP	*Pueraria phaseolides*	dicot	Fabaceae	cover crop
RC	*Ricinus communis*	dicot	Euphorbiaceae	cover crop
SG	*Stylosanthes guianensis*	dicot	Fabaceae	cover crop
TP	*Tagetes patula*	dicot	Asteraceae	cover crop

tems in the French West Indies and 2 cultivars of banana, at flowering or after six months of growth for longer cycle species. The banana cultivars were: cultivar '902′ (MusaAAA, Cavendish subgroup, Bcav), which is currently used for produce bananas for export all over the world, and the hybrid cultivar'Cirad925' (Musa AAA, a new synthetic hybrid from CIRAD, B925), which shows improved resistance to the fungus *Mycosphaerella fijiensis*. The list of the species and varieties studied is provided in Table 1, along with their taxonomic groups, families and type (cover crop, spontaneous, banana). The cover crop species belongs mainly to Fabaceae family (12 species), but Poaceae (3 species), Euphorbiacea (1 species) and Asteraceae (1 species) were also studied. The spontaneous species belongs to Asteracea and Cucurbitacea families. The list of the variables is provided in Table 2 and 3. Some of them refer to whole plant (7 variables), leaves (21 variables), and roots (12 variables). Only one variable is a categorical variable, the other ones were quantitatively measured. Some variables are raw variables, while others were calculated. Calculation formulas are provided in Table 2. The length of the growth period before flowering (and the observation) is also provided.

Experimental design, materials, and methods

The experiment was conducted at the CIRAD experimental station of Neufchâteau in Guadeloupe (French West Indies), for a period of six months (24 April – 6 November 2013), in a 0.4 ha field previously used as fallow [1]. Soil was andosol (FAO World reference base for soil resources) and plants were rainfed. Cumulated precipitation, mean temperature and mean total solar radiation provide favourable conditions for plant growth all year round (respectively 2829 mm, 25.6 °C and 462 +/− 40 MJ m^2 $month^{-1}$ over the period of the experiment). Fertilisation and weed management around the plants [1; 2] were conducted in order to ensure non-limiting conditions of plant growth and to assess their growth potential in the field. Four plants of the twenty one species/cultivars (see 'Data description' and Table 1) were sown manually in separate 16 m^2 plots distributed randomly within 6 blocks in the field. These four plants corresponded to four repetitions per species/cultivar. On each plants, we measured variables and traits that we assumed related to resource acquisition [see 1; 2]. Traits were measured on each plants i) for short cycle species, when half the twigs had flowered, ii) for long cycles or perennial plants,

Table 2
List of the aboveground variables provided in the dataset.

Abbreviations	Variable names	Units	Organs	Calculation
H	Standing vegetative height	cm	plant	
W1	Maximal crown width	cm	plant	
W2	Crown width perpendicular to W1	cm	plant	
A	Crown projected area	m^2	plant	pi * W1* W2
DW_s	Stem dry weight	g	plant	
$DW_{b,we}$	Leaf blade dry weight of well-exposed leaves	g	leaf	
$DW_{p,we}$	Petiole dry weight of well-exposed leaves	g	leaf	
$DW_{leaf,we}$	Leaf dry weight of well-exposed leaves	g	leaf	$DW_{b,we} + DW_{p,we}$
DW_b	Leaf blade dry weight	g	leaf	
DW_p	Petiole dry weight	g	leaf	
DW_{leaf}	Leaf dry weight	g	leaf	$DW_b + DW_p$
BMa	Aboveground dry biomass	g	plant	$DW_s + DW_{leaf}$
PBR	Petiole to leaf blade weight ratio	g/g	plant	DW_p/DW_b
$LMFa_b$	Aboveground leaf mass fraction without petioles	g/g	leaf	DW_b/BMa
LMFa	Aboveground leaf mass fraction with petioles	g/g	leaf	DW_{leaf}/Bma
LDMC	Leaf dry matter content	mg/g	leaf	
$LDMC_{ps}$	Leaf dry matter content at plant scale	mg/g	leaf	
SLA_b	Specific leaf area without petioles	m^2/kg	leaf	
SLA	Specific leaf area with petioles	m^2/kg	leaf	
$SLA_{b,ps}$	Specific leaf area without petioles at the plant scale	m^2/kg	leaf	
SLA_{ps}	Specific leaf area with petioles at the plant scale	m^2/kg	leaf	
$LARa_{b,ps}$	Aboveground leaf area ratio without petioles at the plant scale	m^2/kg	leaf	$LMFa_b$ * $SLA_{b,ps}$
$LARa_{ps}$	Aboveground leaf area ratio with petioles at the plant scale	m^2/kg	leaf	LMFa * $SLA_{b,ps}$
$LARa_b$	Aboveground leaf area ratio without petioles	m^2/kg	leaf	$LMFa_b$ * SLA_b
LARa	Aboveground leaf area ratio with petioles	m^2/kg	leaf	LMFa * SLA_b
LA	Total leaf blade area	m^2	leaf	DW_b * $SLA_{p,ps}$
LSA	Leaf to soil ratio	m^2/m^2	leaf	LA/A
LNC	Leaf dry matter content	%	leaf	

Table 3
List of the underground variables provided in the dataset.

Abbreviations	Variable names	Units	Organs
RD_{max}	Maximal rooting depth	cm	root
RD_{med}	Median rooting depth	cm	root
RW_{max}	Maximal rooting width	cm	root
Nod	Nodule activity	*categorical*	root
Diam	Mean root diameter	mm	root
SRL	Specific root length	m/g	root
RLD	Root length density	cm/cm^3	root
RWD	Root weight density	g/cm^3	root
$RID_{0–20}$	Root impact density in the 0–20 soil layer explored by the roots	$/dm^2$	root
$RID_{20–40}$	Root impact density in the 20–40 soil layer explored by the roots	$/dm^2$	root
$RID_{40–60}$	Root impact density in the 40–60 soil layer explored by the roots	$/dm^2$	root
$RID_{60–80}$	Root impact density in the 60–80 soil layer explored by the roots	$/dm^2$	root

at the end of the experiment (i.e. after ~6.5 months of growth). The length of this growth period was reported as the number of days after sowing (**DAS**). Traits measurements methods are provided in the related research articles [1; 2], however, we provide deeper information below.

Aboveground measurements

All measured variables are presented in Table 2.

The standing vegetative height and crown widths were measured at one sampling date per species, with a tape measure. Standing vegetative height (**H**) was measured from the bottom of

the plant at the soil interface to the top of the higher vegetative organ, without stretching the plant. We considered that the crown projection on the soil could be modelled by an ellipse. Two crown widths were then measured: **W1**, the maximal crown width and **W2**, the crown width perpendicular to W1. The crown projected area (**A**) was then calculated (Table 2).

At the top of each plant, three well-exposed leaves were harvested precociously, according to standardized protocols for the measurement of SLA [3]. Just after harvest, the leaves were placed in a plastic bag containing wet paper and stored in a cooler for less than 15 min. Then, the petioles[1] and leaf blades were weighed and scanned at 200 dots per inch (scanner Epson expression 10,000XL Pro) separately. They were then oven dried at 70 °C for 48 h and weighted again. Petioles and leaf blades area were measured with WinRHIZO Pro 2009a software (Regent Instruments, Quebec, Canada). The dry weight of the leaf blades and petioles of the well-exposed leaves ($\mathbf{DW_{b,we}}$ resp. $\mathbf{DW_{p,we}}$) were registered. The dry weight of the well-exposed leaves ($\mathbf{DW_{leaf,we}}$) was calculated (Table 2). The leaf dry matter content (**LDMC**) was calculated by dividing the fresh biomass of the whole well-exposed leaves (petiole + leaf blade) by their dry biomass. The specific leaf area was calculated in two different ways. The specific leaf area with petiole (**SLA**) was calculated by dividing the whole leaf area (petiole + leaf blade) by its dry biomass. The specific leaf area without petiole ($\mathbf{SLA_b}$) was calculated by dividing the leaf blade area by its dry biomass.[2] Finally, the leaf nitrogen content (**LNC**) was determined by pooling the sampled well-exposed leaves of the four repetitions per species. LNC was determined as the total nitrogen content on a mass basis, measured according to Dumas method (CHN analyser, Elementar Vario Macro Cube).

A sample of leaves (petioles and leaf blades separately) was then collected on the whole plant to calculated specific leaf areas at the plant scale. To do so, petiole and leaf blade samples were weighed, scanned at 200 dots per inch and oven-dried for 48 h at 70 °C. The specific leaf area with petiole at the plant scale ($\mathbf{SLA_{ps}}$) was calculated by dividing the whole leaf area of the sample (petiole + leaf blade) by its dry biomass. The specific leaf area without petiole at the plant scale ($\mathbf{SLA_{b,ps}}$) was calculated by dividing the leaf blade area of the sample by its dry biomass.

The rest of the plant was finally harvested and separated into stems, petioles and leaf blades. Each component was weighed separately, oven-dried for 48 h at 70 °C and then weighted again. The leaf dry matter content at the plant scale ($\mathbf{LDMC_{ps}}$) was calculated by dividing the total fresh biomass of the whole leaves (petiole + leaf blade, including the leaves used for SLAs determinations) by its dry biomass. The dry weight of the stems ($\mathbf{DW_s}$), of the leaf blades ($\mathbf{DW_b}$) and of the petioles ($\mathbf{DW_p}$) (DW_s and DW_p including the leaves used for SLAs determinations) were registered. The total leaf blade area (**LA**), the leaf to soil ration (**LSA**), the leaf blade to petiole ratio (**PBR**), the total leaf dry weight ($\mathbf{DW_{leaf}}$) and the aboveground dry biomass (**BMa**) were then calculated as described in Table 2. The aboveground leaf mass fraction with and without petioles (**LMFa** resp. $\mathbf{LMFa_b}$) were calculated by dividing the leaf dry weight (DW_{leaf} resp. DW_b) by BMa. The aboveground leaf area ratio was calculated with and without petioles, on well-exposed leaves and at the plant scale (**LARa, $\mathbf{LARa_b}$, $\mathbf{LARa_{ps}}$, $\mathbf{LARa_{b,ps}}$**) by multiplying the corresponding LMF and SLA (see Table 2 for the exact calculation formulas).

Belowground measurements

All measured variables are presented in Table 3.

Belowground traits were assessed, for each plant, in a 1-m deep and 1-m wide trench that was dug 20 cm from the base of the plant. The root intersections in the vertical soil profile were

[1] The rachis of compound leaves was considered as petiole and included in the "petiole" compartment. For monocots (except banana), leaves were cut at their insertion on the stem, without collecting leaf sheaths. As a consequence, "petiole" compartment is absent for monocots.

[2] For monocots (except banana), SLA and SLA_b were considered equal (and as consequence LMFa and $LMFa_b$, LARa and $LARa_b$, $LARa_{ps}$ and $LARa_{b,ps}$).

counted on a 5 cm × 5 cm mesh grid. The root impact density in soil layers explored by the roots were calculated as the number of root impacts observed divided by the surface of soil profile explored in this layer. For example, the root impact density in the 0–20 soil layer explored by the roots (**RID_{0-20}**) was calculated as the number of root intersections observed in this layer divided by the product of the height of the layer (20 cm) and the distance between the further root observed in this layer and the plant base. The root impact density in the 20–40, 40–60 and 60–80 soil layers explored by the roots (**RID_{20-40}, RID_{40-60}** and **RID_{60-80}**) were calculated similarly. The maximal rooting depth (**RD_{max}**) was determined by the deepest root intersection that was observed. The maximal rooting width (**RW_{max}**) was determined by the furthest root intersection that was observed from the plant base, whatever its depth. The median rooting depth (**RD_{med}**) was calculated as the depth at which 50% of the root intersections were observed.

For each plant, three cubes of 1000 cm^3 of soil samples were removed: i) under the base of the plant at a depth of 0 to 10 cm, ii) under the base of the plant at a depth corresponding to half the maximum rooting depth, iii) at half the maximum rooting width and depth. Each sample was carefully washed to collect fine and coarse roots. The presence and activity of nodules (**Nod**) was assessed with a four-category variable (0: absence of nodules, 1: small white nodules, 2: medium size pink nodules, 3: large pink nodules). The roots were scanned at 400 dots per inch (scanner Epson expression 10000XL Pro-scanner). The length and diameter of each root sample were measured with WinRHIZO Pro 2009a software (Regent Instruments, Quebec, Canada). The mean root diameter (**Diam**) was calculated by averaging the diameters of the three samples per plant. The roots contained in the three soil samples were then pooled and weighed after drying for 72 h at 70 °C. The specific root length (**SRL**) was calculated by dividing the total length of the roots in the three samples by their root dry biomass. The root length density (**RLD**) and the root weight density (**RWD**) were calculated by dividing, respectively, the total length and the total dry biomass of the roots in the three samples by the cumulated volume of these three samples (i.e. 3000 cm^3).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

Acknowledgments

This experimental work was supported by the projects “AGROECOTROP” from E.U. FEDER. This valorization was supported by the project “TACOS” (ID 1702–014), which was publicly funded through ANR (the French National Research Agency) under the "Investissements d’avenir" programme with the reference ANR-10-LABX-001–01 Labex Agro and coordinated by Agropolis Fondation under the frame of I-SITE MUSE (ANR-16-IDEX-0006). The authors thank Charles Meynard, Mylène Ramassamy, Steewy Lakhia, Christina Racel, and Jean-Luc Jean-Louis for their technical support, and the laboratory “CIRAD US 49″ for chemical analysis.

Author contributions

GD: Methodology, Supervision, Writing, Funding acquisition. **FT**: Methodology, Data acquisition, Data curation, Formal analysis. **MD & DM**: Methodology, Supervision, Funding acquisition.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105890.

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