DESCUBRE

essential COSTA RICA

PROCOMER COSTA RICA | EXPORTS INVESTMENT

Determination of the Growth Curve and Absorption of Diffe-rend Macro and Micronutroents for the Cultivation of Abaca (Musa Textiles)

IN THE AREA OF GUACIMO LIMON, COSTA RICA

SUMMARY

As part of the DESCUBRE program of the Foreign Trade Promoter of Costa Rica (PROCOMER), with the objective of technically advising projects with export potential, the growth curve and nutritional absorption for the cultivation of abacá (M. textilis) were carried out in the Guácimo area, Limón, Costa Rica. The trial was conducted by Biotech CR GRM S.A on the experimental farm located in Río Jiménez de Guácimo, in the province of Limón, Costa Rica; the farm is located at coordinates 9°57.314'N and 83°59.684'W with an altitude of 50 m above sea level. The trial began with the planting of the plantation in November 2021 and ended with the last commercial harvest in May 2023. Sampling was carried out every 30 days during the growth of the plantation up to 5 months, and subsequently every 45 days until the start of the harvest. During each sampling, biometric variables were evaluated: height, number of leaves, and pseudostem diameter; additionally, fresh weight of pseudostem, leaves, and corm + root. Samples of each of these organs were sent in triplicate for nutritional analysis, and quintuplicate for dry weight and moisture percentage analysis. The growth curve and dry matter accumulation presented four stages, the first period which extended from planting to 120 days (establishment), from 120 to 240 days (vegetative growth), from 240 to 330 days (suckering), and 330 to 480 days (pseudostem growth). It was observed that the appearance of suckers was a moment of high importance in the development of the crop. Nutrient absorption was proportional to the growth curve, with a high consumption of nutrients from 240 days after planting (DAP). The macroelements with the highest consumption were potassium, nitrogen, calcium, phosphorus, magnesium, and sulfur, in that order. The microelements with the highest consumption (in order of importance) were iron, manganese, zinc, boron, and copper. The production obtained was 7985 kg/ha of fiber, distributed in 80.4% of the first quality and 19.6% of the second quality. It is recommended to make at least one application with a complete formula (N-P-K) at an age close to 300 days after planting, in addition to fragmenting the application doses increasing at ages after 240 days, as well as incorporating the application of

microelements in fertilization.

CONTENT

A. **GENERAL INFORMATION** 4

B. **GENERALITIES OF THE CROP** 4

C. **OBJECIVES** 5

C.1. General Objective 5

C.2. Specific Objective 5

D. **METHODOLOGY** 6

D.1. Selection of the crop and cultivar 6

D.2. Trial conditions 6

D.3. Design and installation of the trial 7

D.4. **Commercial maintenance of the plantation** 8

D.5. **Modes of evaluating, quantifying, recording** 8

D.5.1. Meteorological and soil data 8

D.5.2. Soil data: 9

D.5.3 Irrigation data 9

D.7. **Type, timing, and frequency of evaluations** 9

D.7.1. Type 9

D.7.2. Timing and frequency 9

D.8. **Data Analysis** 10

E. **RESULTS** 11

E.1. **GROWTH CURVES IN ABACÁ CULTIVATION (M. TEXTILIS)** 11

E.2. **NUTRIENT ABSORPTION CURVES IN ABACÁ CULTIVATION (M. TEXTILIS)** 13

E.3. **TOTAL EXTRACTION IN ABACÁ CULTIVATION (M. TEXTILIS)** 24

E.4. **FERTILIZATION AND YIELD** 25

F. **CONCLUSIONS** 28

G. **RECOMENDATIONS** 29

H. **BIBLIOGRAPHIC REFERENCES** 30

I. **ANEXXES** 31

A. GENERAL INFORMATION

Research start date: November 2021

Location of the trial: Biotech Experimental Station located in Guácimo, Limón, Costa Rica, specifically at coordinates 9°57.314'N and 83°59.684'W.

B. GENERALITIES OF THE CROP

M. textilis also known as abacá or Manila hemp, belongs to the Musaceae family and originally comes from the Philippines, where the production of this crop took place exclusively until World War II. As a result, large companies have undertaken the task of searching for suitable areas for the cultivation of this crop, showing that countries in the humid tropical belt, such as Costa Rica, meet the necessary characteristics for this product to be optimally cultivated *(Sambonino et al. 2017).*

This herbaceous plant is characterized by the fiber extracted from its stems, each fiber composed of long and thin cells with a high lignin content, making up about 15% of its composition. This component determines the hardness of the cell wall, giving it great mechanical strength and resistance to damage by saltwater (FAO 2021).

From the fiber obtained in the cultivation of Abacá, various by-products have been developed, such as paper, ropes, twines, cords, fishing lines, and rough fabric for sacks, among others. However, one of the main products made from this fiber is tea bags (*Sambonino et al.* 2017).

The global demand for Abacá, whose main importers are the United States, the European Union, Japan, and India, is around 80,000 metric tons, with the Philippines being the leading exporter of Abacá, accounting for about 87% of global production, Ecuador with 12%, while other countries like Costa Rica, which also trade the product, export only 1% of that demand. However, the climatic, social, and political conditions in certain areas of our country such as Limón, Heredia (Río Frío, Sarapiquí), and Puntarenas, make it an ideal scenario for expanding

the development of this crop (Biodiversity and Business Program 2020).

Considering that the market prospects for Abacá are broad, due to the possibilities it represents, for example, in replacing fiberglass and other by-products, it is necessary to establish and regulate agricultural practices that optimize the production of this crop, so that these practices are not based solely on the experience acquired by some producers or carried out by adapting information developed in other countries, as occurs with absorption curves, necessary for meeting the nutrient absorption needs in the crop (Bertsch 2003).

Since nutrient extraction depends on various factors, such as the genetic potential or age of the plant, temperature, humidity, soil, etc., as Sancho (1999) states, it makes each curve specific for each crop-variety. Even as recommended by Cabalceta (2005), it is necessary to establish the crop growth curve (dry weight of biomass) in order to determine the phenological stages of the crop and the percentage of participation of the different tissues that compose it.

C. OBJECTIVES

C.1. General Objective

Determine the growth and absorption curve (macro and micronutrients) for the cultivation of Abacá (*M. textilis*) in the Guácimo area, Limón, Costa Rica.

C.2. Specific Objective

Record the growth of Abacá *(M. textilis)* cultivation and the development of its phenological stages.

Cuantificar la producción de materia seca del cultivo de Abacá (*M. textilis*) y su relación con la fenología.

Quantify the production of dry matter in Abacá (M. textilis) cultivation and its relationship with phenology.

Determine the consumption curve of macro and micronutrients in Abacá (*M. textilis)* cultivation.

Establish a specific fertilization proposal for the cultivation of Abacá *(M. textilis*) in the Guácimo area, Limón, Costa Rica.

D. METHODOLOGY

D.1. Selection of the Crop and Cultivar

M. textilis, also known as abacá and Manila hemp, belongs to the *Musaceae* family. It is an herbaceous plant native to the Philippines, which can reach 5 to 7 meters in height in warm places with high rainfall, with an underground rhizomatous stem and aerial pseudostem formed by erect leaf sheaths, whose composition is mainly cellulose, lignin, and pectin. It is characterized by the production of non-edible fruits due to their high seed content and for presenting more upright and narrow foliage compared to other Musaceae species belonging to the same genus. This species has been established in the southern Atlantic region (Talamanca, Limón), where it is common in open areas and riverbanks (Morales 2020).

The plants used during the trial were produced in a laboratory using in vitro cultivation techniques and later acclimatized in a nursery. Commercial production vitroplants were used.

D.2. Trial Conditions

The trial was established at the Biotech Experimental Station in November 2021, located in Río Jiménez de Guácimo, Limón, Costa Rica, specifically at the geographical coordinates 9°57.314'N and 83°59.684'W, at an altitude of 36 m above sea level, the Holdridge life zone is classified as a tropical moist forest, transitioning to perhumid (Bolaños, Watson, and Tosi, 2005).

The experimental area received a commercial management program that includes: applications of herbicides, application of fertilizers, and cultural practices (de-budding, de-leafing, clearing, among others), such tasks were carried out under the same conditions for each of the replications.

Figure 1. Biotech Experimental Station, Guácimo, Limón, Costa Rica

D.3. Design and Installation of the Trial

The trial was established with a randomized complete block design and consisted of a single treatment with three replications, each constituted by plots of 200 plants distributed in an approximate area of 1700 m2, for a total area of 0.51 ha. The design allowed sampling plants without using the edges or the heads, sampling 5 plants in each replication. The planting distance implemented was 3 m between plants and 3 m between rows, for a density of 1111 plants per hectare.

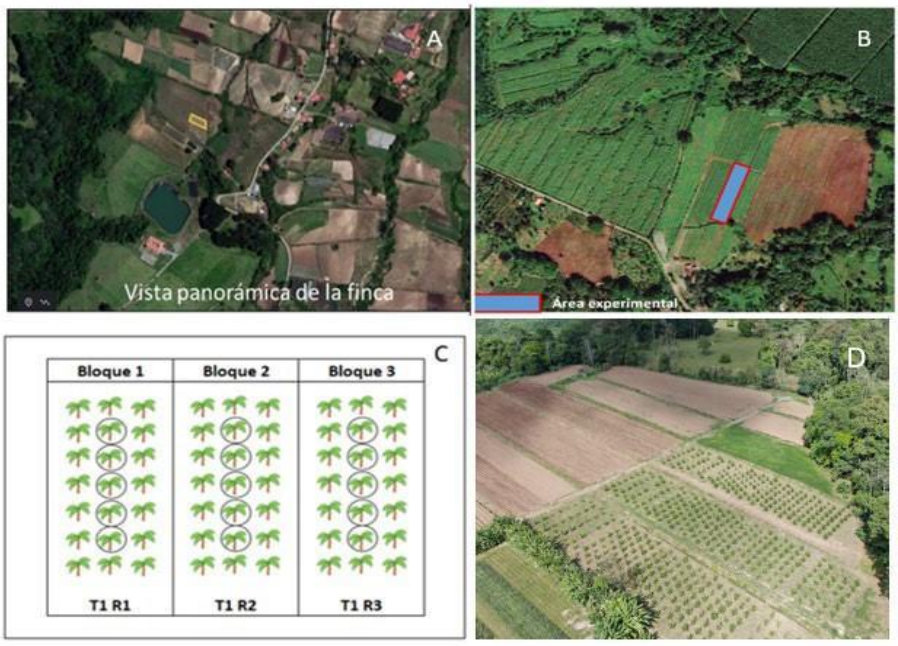

Figure 2. A: Panoramic view of the Biotech experimental farm, B: Experimental area, C: Distribution.

D: Plots in experimental farm in the field of research plots. PPhy 107-21

D.4. Commercial Maintenance of the Plantation

Pest and Insect Diseases

Some defoliating pests were present, for which Diazinon was used with an application volume of 80 liters per hectare.

Fertilization

Four applications of granular fertilizer were made, the first was a 10-30-10 formula in physical mixture at the time of planting directed to the "planting hole" at a rate of 100 grams per plant, followed by three cycles with the formula 18-5-15 6 - 0.2 (B) -2.5 (S) at a quarterly frequency, adding 100 grams per plant. Additionally, three foliar applications of multimineral were carried out during the first month after planting, in order to improve nutritional condition and reduce transplant stress.

De-suckering

This was carried out depending on the location, vigor, and direction desired for the plantation.

D.5. Modes of Evaluating, Quantifying, Recording

D.5.1. Meteorological and Soil Data:

Meteorological data (average daily temperature, average daily relative humidity, and daily accumulated precipitation) are reported during the development of the trial (Annex 1, Figure 2).

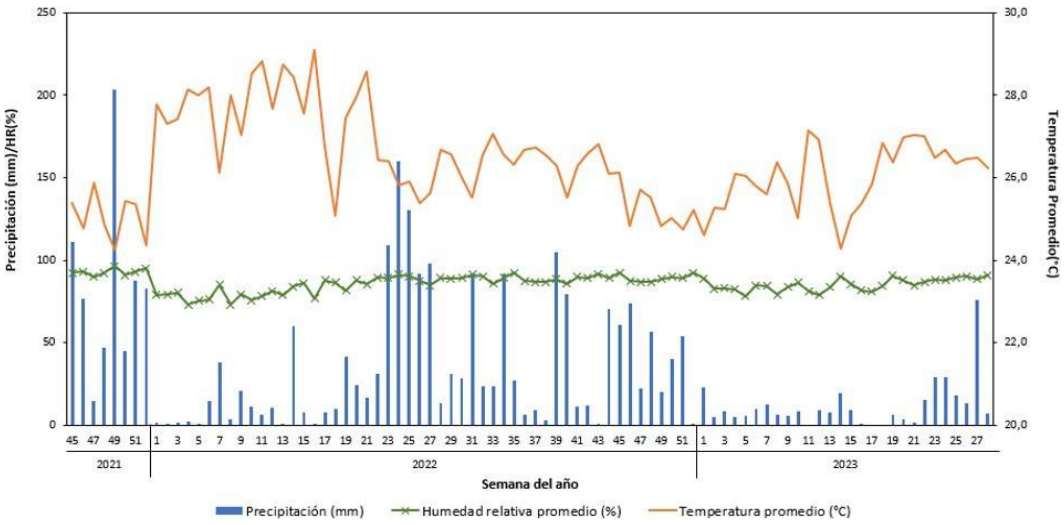

Figure 3. Graphs of meteorological data during the trial

D.5.2. Soil Data:

The data on pH, complete chemical content and organic matter, gravimetric moisture, and soil texture are annexed (Table 1, Annex 2, Annex 3, Annex 4).

Table 1. Summary table of soil analysis from the farm where the trial was conducted. PPhy 107-21

Farm	Location	% Carbon (C)	% Nitrogen (N)	C/N Relation	Texture	pH	% Gravimetric Moisture
Experimental Biotech	Guácimo-Limón	3.09	0.38	8.1	Sandy Clay Loam	5.7	37

D.5.3 Irrigation Data:

Due to the cultivation conditions, irrigation was not performed. However, the precipitation of the area was recorded, which was indicated in the meteorological data. D.7. Type, Timing, and Frequency of Evaluations

D.7. Type, timing and frequency of evaluations

D.7.1. Type:

To determine the growth curve, samplings were carried out every 30 days up to 5 months, and subsequently continued every 45 days up to 14 months. Each sample consisted of 5 plants, avoiding edges and heads. In each sampling, plants were separated into corm + root, pseudostem, foliage, and suckers. The fresh weight of each plant segment was measured. Subsequently, samples were sent to the laboratory. For the dry weight variable, 5 samples for each plant organ were used.

Each sample was analyzed for concentrations of nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, zinc, boron, iron, manganese, copper, chlorine, aluminum, and molybdenum. As the samplings were destructive, an area was maintained for harvest in May 2023. Each composite sample was distributed into three tissues: foliage, pseudostem, and corm plus root.

D.7.2. Timing and Frequency:

The crop growth evaluations were carried out bi-weekly until the time of harvest. The first evaluation was performed 30 days after transplanting the crop. The crop nutrient absorption evaluations were initially carried out monthly (during the first 4 months of the plantation development), once the plant developed suckers, the samplings were carried out every 45 days until the time close to the harvest, for a total of 11 evaluations. The analysis of micro-macronutrients and dry matter was carried out in the Soil and Foliar Laboratory (LSF) of the Center for Agricultural Research (CIA), at the University of Costa Rica.

D.8. Data Analysis

The total absorption of nutrients was estimated, which consisted of multiplying the concentration of each element by the dry weight (biomass) for each studied fraction of the plant, in this case, foliage, pseudostem, and corm plus root. Using the following equations:

When concentrations are expressed in percentage:

NUT kg ha-1= [(PS tissue (kg ha-1) x (NUT%)]/100

When concentrations are expressed in mg kg-1:

NUT kg ha-1= [(PS tissue (kg ha-1) x (NUT mg kg-1)]/1000

Where NUT= Concentration of the element (nutrient).

The increase in the average amount of nutrients absorbed for each sampling period (absorption curve) was estimated. It was obtained from the total amount of the nutrient absorbed in each phenological stage, from which the amount obtained in the previous evaluation period was subtracted.

The representativeness of the samples taken throughout the study was determined by calculating averages, standard deviations (S.D.), and coefficients of variation (C.V.) of the data, so that samples with a CV of ≤20 were considered representative.

For the processing of growth data, a curve was generated that expresses the behavior of the dependent variable (biometric variables) in relation to the independent variable (days after transplant), with the average of the replications.

E. RESULTS

E.1. GROWTH CURVES IN ABACÁ CULTIVATION (*M. TEXTILIS*)

The growth curve was made with the dry matter data for each sampled organ, associating it with the age at which it was sampled. Biomass accumulation presented four stages (Figure 4). The first period comprised from planting to 120 days after planting (DAP) (establishment); the second from 120 to 240 DAP (vegetative growth); then, from 240 to 330 DAP (suckering); and the fourth stage was from 330 to 480 DAP (pseudostem growth).

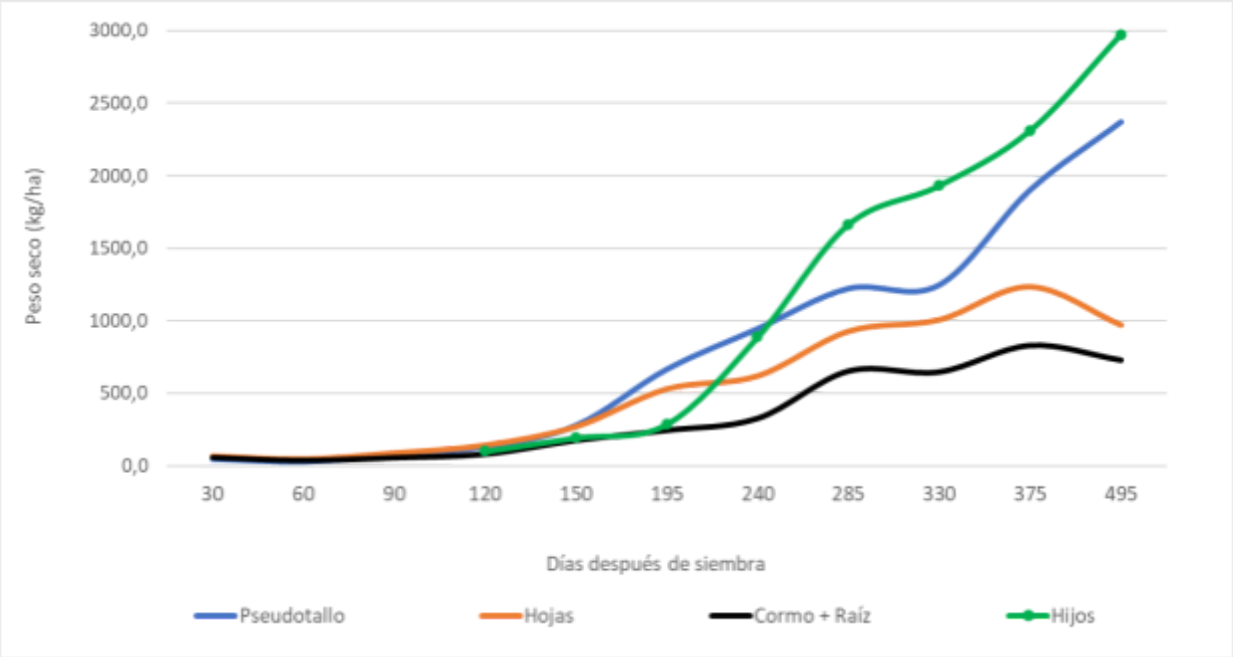

Figure 4. Growth curve for abacá cultivation (*M. textilis)* in the Guácimo area, Limón, Costa Rica

Generally, the tissues had between 82 and 93% moisture, with the pseudostem being the organ with the highest percentage. The pseudostem was the organ that accumulated the most dry matter up to 285 DAP, when the suckers began to be the organ with the highest accumulation of dry biomass. The pseudostem, which includes the commercially usable fiber of the plant, had the highest gain in dry matter after 330 DAP, accumulating in this last period 61.8% of total dry matter (Table 2).

Table 2. Dry biomass for each organ of the abacá plant in the Guácimo area of Limón, Costa Rica

Age (days)	Dry biomass (g)			
	Pseudostem	Leaves	Corm + Raíz	Suckers
30	49,0	69,4	56,8	
60	29,7	48,7	36,2	
90	73,7	90,3	55,2	
120	133,6	143,9	80,0	96,9
150	280,2	272,5	175,2	191,3
195	666,6	531,8	244,6	284,2
240	945,6	621,9	326,9	884,6
285	1222,4	929,8	653,9	1662,1
330	1246,6	1009	648,0	1929,8
375	1900,7	1236,5	831,2	2309,1
495	2368,6	973,1	729,7	2971,4
Accumulated Total	8916,9	5927,0	3837,6	10329,3
% Humdity (average)	93,2	82	88	89

The growth of the mother plant's pseudostem was continuous, even at 360 DAP it continued with significant gains, between 8 and 12% in height, and between 5 and 6% in circumference, in the period between 300 and 360 DAP (Table 3).

Table 3. Development of biometric variables of height, circumference, number of leaves, and number of suckers for abacá plants in the Guácimo area, Limón, Costa Rica

Age (days)	Height (cm)	Circumference (cm)	Number of leaves	Number of suckers*
30	39,67	11,58	6,25	
60	60,80	15,87	8,33	
90	82,40	19,71	9,30	
120	116,84	24,43	9,58	4
150	140,47	27,13	9,28	5
180	181,4	31,8	9,33	
210	207,85	34,56	9,33	
240	240,95	37,51	8,35	7
270	266,09	38,91	7,9	7
300	289,42	40,39	7,39	
330	313,57	42,43	7,18	7
360	353,67	44,68	6,87	6

* Includes formation and maintenance de-suckering.

Biometric Variables Methodology:

Height was determined from the base of the plant to the flag leaf, using a tape measure. In the case of circumference, it was measured with a tape measure at 1.5m from the stem.

E.2. NUTRIENT ABSORPTION CURVES IN ABACÁ CULTIVATION (*M. TEXTILIS*)

The different nutrient absorption curves had their own behavior depending on the tissue, the time of the phenological cycle of the crop, and the nutrient to be evaluated.

Cuadro 15. Amount of nutrient absorbed for each tissue throughout the productive cycle of the Abacá *(M.textilis)* crop, mother plant

Tissue	Days after planting	Absorbed quantity Mother Plant Kg/ha							g/ha			
	(dds)	N	P	Ca	Mg	K	S	Fe	Cu	Zn	Mn	B
Leaves	30	2,32	0,16	0,54	0,19	1,99	0,16	9,32	0,58	2,58	47,25	0,56
	60	1,56	0,09	0,52	0,13	2,00	0,09	13,41	0,39	1,18	48,07	0,46
	90	3,19	0,18	0,96	0,27	3,11	0,21	19,53	1,03	1,95	91,09	0,72
	120	4,55	0,27	1,60	0,39	5,58	0,33	29,21	1,49	2,83	81,09	1,22
	150	7,40	0,46	2,40	0,67	10,11	0,61	18,98	2,49	4,84	86,34	2,56
	195	13,58	0,83	4,19	1,06	17,90	1,07	58,59	3,88	8,98	146,74	6,07
	240	12,73	1,16	2,86	1,06	20,76	1,08	36,35	4,35	11,61	126,66	7,05
	285	18,34	1,52	6,78	1,64	27,92	1,58	334,62	6,19	19,22	236,96	12,08
	330	19,70	2,15	7,18	2,55	29,17	2,12	257,93	6,62	20,08	264,80	12,35
	375	23,73	2,69	9,17	3,05	34,37	2,46	333,22	7,25	24,48	280,89	14,30
	495	13,32	2,24	6,09	2,00	24,35	1,46	266,77	4,87	17,30	164,62	10,96
Pseudostem	30	1,09	0,14	0,30	0,09	2,51	0,06	17,24	0,41	8,97	15,50	1,14
	60	0,59	0,05	0,20	0,05	2,01	0,03	3,99	0,12	1,86	9,93	0,85
	90	1,33	0,12	0,53	0,12	4,60	0,07	26,91	0,49	3,67	14,21	1,65
	120	2,08	0,21	0,84	0,19	9,03	0,14	27,44	0,98	5,43	14,42	2,92
	150	2,64	0,36	1,82	0,31	17,01	0,23	38,69	1,44	6,33	32,53	6,10
	195	5,54	0,72	4,20	0,54	31,96	0,47	125,70	2,71	13,86	82,89	15,27
	240	5,41	1,03	4,62	0,54	41,55	0,60	177,15	3,51	12,92	104,12	16,58
	285	6,76	1,34	7,00	0,92	52,32	0,77	265,58	6,50	22,15	141,73	28,12
	330	5,98	1,64	7,03	1,08	50,43	0,72	430,48	4,88	22,54	126,43	27,58
	375	10,77	3,61	10,77	1,96	83,91	1,33	545,97	7,60	66,48	184,35	39,63
	495	10,98	4,07	11,65	1,99	53,03	1,46	941,28	5,88	46,50	202,50	33,91
Corm	30	1,12	0,13	0,31	0,27	1,47	0,08	346,88	1,31	23,24	15,98	2,18
	60	0,60	0,05	0,21	0,10	0,81	0,03	143,31	0,56	8,10	8,78	1,36
	90	0,88	0,09	0,30	0,19	1,80	0,06	164,76	1,04	11,66	14,67	2,46
	120	1,22	0,11	0,46	0,23	3,69	0,08	346,89	1,89	9,56	18,07	5,51
	150	2,15	0,21	1,12	0,45	7,00	0,17	187,64	2,88	7,57	30,43	8,69
	195	2,60	0,26	1,53	0,47	9,57	0,22	431,57	3,68	12,37	37,11	19,25
	240	2,67	0,38	1,80	0,51	11,97	0,35	411,12	4,48	12,66	45,93	21,05
	285	4,84	0,60	3,35	0,98	19,46	0,56	635,68	8,74	21,78	72,89	37,23
	330	4,50	0,66	3,51	1,11	19,30	0,63	695,37	6,98	23,99	72,14	36,80
	375	5,33	0,89	4,44	1,49	23,86	0,80	1183,77	10,03	34,03	89,57	50,51
	495	4,05	0,61	3,34	1,10	13,12	0,64	531,54	5,58	22,41	62,47	41,48
Total	30	4,52	0,42	1,15	0,55	5,98	0,31	373,45	2,30	34,78	78,73	3,88
	60	2,76	0,20	0,92	0,27	4,82	0,15	160,71	1,08	11,13	66,78	2,66
	90	5,40	0,39	1,79	0,58	9,51	0,34	211,21	2,57	17,28	119,97	4,84
	120	7,85	0,60	2,89	0,81	18,30	0,55	403,54	4,36	17,81	113,58	9,64
	150	12,19	1,03	5,34	1,43	34,11	1,00	245,32	6,81	18,75	149,30	17,35
	195	21,72	1,80	9,92	2,07	59,42	1,76	615,86	10,27	35,21	266,74	40,59
	240	20,80	2,57	9,28	2,11	74,29	2,03	624,61	12,34	37,20	276,71	44,67
	285	29,94	3,46	17,13	3,54	99,69	2,91	1235,88	21,43	63,15	451,58	77,43
	330	30,19	4,45	17,72	4,75	98,91	3,47	1383,78	18,48	66,60	463,37	76,73
	375	39,83	7,19	24,37	6,51	142,14	4,59	2062,95	24,89	124,99	554,82	104,44
	495	28,35	6,92	21,08	5,09	90,50	3,56	1739,59	16,33	86,21	429,59	86,35

Table 16. Amount of nutrient absorbed for each tissue throughout the productive cycle of the abacá *(M. textilis)* crop, sucker

Tissue	Days after planting (dds)	Absorbed quantity of nutrients Sucker Kg/ha N	P	Ca	Mg	K	S	g/ha Fe
			Cu	Zn	Mn	B		
Leaves	120	1,12	0,09	0,30	0,12	1,40	0,09	12,15	0,43	0,85	19,54	0,32
	150	1,77	0,12	0,59	0,19	2,33	0,15	7,21	0,55	1,10	27,36	0,49
	195	2,77	0,24	0,73	0,24	4,60	0,25	35,00	1,13	2,16	27,07	1,13
	240	8,33	0,68	1,71	0,58	12,37	0,71	41,33	2,58	6,14	98,17	2,91
	285	13,94	1,31	3,89	1,26	20,46	1,26	541,78	6,29	13,72	220,60	8,57
	330	13,93	1,77	5,45	1,98	24,54	1,70	217,85	5,66	16,98	212,19	9,19
	375	16,34	1,96	4,49	2,21	24,19	1,80	146,26	5,72	15,53	147,90	8,17
Pseudostem	495	11,83	1,85	5,74	2,38	23,48	1,59	121,79	3,53	14,12	130,61	8,83
	120	0,60	0,11	0,19	0,07	2,32	0,04	13,58	0,29	1,25	8,55	0,43
	150	0,90	0,14	0,44	0,12	4,74	0,06	16,90	0,39	2,09	12,71	0,85
	195	1,31	0,23	0,71	0,13	7,79	0,11	16,06	0,73	2,43	20,69	1,46
	240	3,13	1,00	2,46	0,42	25,30	0,33	278,85	2,50	10,84	57,94	6,25
	285	5,68	1,20	5,12	0,64	49,21	0,56	473,74	4,80	17,61	130,44	12,80
	330	3,81	2,11	3,72	1,02	40,26	0,59	279,99	3,38	13,53	76,98	11,00
	375	6,44	2,97	5,45	1,29	48,45	0,79	1159,17	6,94	23,78	107,99	13,87
Corm	495	7,72	2,78	8,96	1,54	44,79	0,93	1010,01	6,18	21,62	162,16	16,99
	120	0,42	0,04	0,13	0,07	1,10	0,03	22,17	0,39	2,54	4,52	0,33
	150	0,61	0,08	0,26	0,14	2,17	0,05	159,78	0,95	3,95	9,91	0,74
	195	0,67	0,09	0,26	0,11	2,45	0,06	84,40	0,77	2,80	8,17	0,95
	240	1,51	0,23	0,96	0,26	7,61	0,19	287,44	2,17	7,39	28,69	3,19
	285	2,90	0,35	1,54	0,49	12,45	0,29	525,78	4,94	12,48	46,45	4,94
	330	2,18	0,41	1,32	0,68	11,07	0,30	219,94	3,01	7,91	31,64	4,14
	375	3,46	0,55	2,46	1,10	13,63	0,55	749,37	6,02	18,05	60,65	6,52
Total	495	3,05	0,60	1,47	1,09	9,42	0,33	1830,02	8,17	13,61	66,43	7,08
	120	2,13	0,25	0,63	0,26	4,82	0,15	47,90	1,10	4,64	32,61	1,08
	150	3,28	0,34	1,29	0,46	9,25	0,26	183,88	1,89	7,14	49,98	2,08
	195	4,76	0,56	1,69	0,48	14,84	0,42	135,46	2,64	7,40	55,92	3,55
	240	12,96	1,91	5,13	1,26	45,27	1,23	607,63	7,26	24,36	184,79	12,35
	285	22,53	2,86	10,55	2,39	82,13	2,11	1541,29	16,02	43,80	397,49	26,31
	330	19,92	4,30	10,49	3,67	75,88	2,59	717,78	12,05	38,42	320,80	24,33
	375	26,24	5,48	12,40	4,60	86,27	3,14	2054,81	18,67	57,35	316,54	28,56
	495	22,60	5,23	16,16	5,02	77,68	2,84	2961,83	17,87	49,35	359,20	32,89

Nitrogen absorption was low in the first establishment stage, accumulating 7% before 120 DAP. With the increase in growth and biomass of the plant, a process of high consumption began, culminating at 375 DAP with 84% of the total nitrogen consumption. During this last stage of the crop, the highest nitrogen absorption came from the suckers of the mother plant, which were in a stage of vegetative growth. By the end of the trial, the total amount of nitrogen absorbed was 317 kg/ha. The organ with the highest nitrogen absorption in the mother plant was the foliage, and for the last evaluation, at harvest, a decrease in nitrogen absorption was observed (Figure 5).

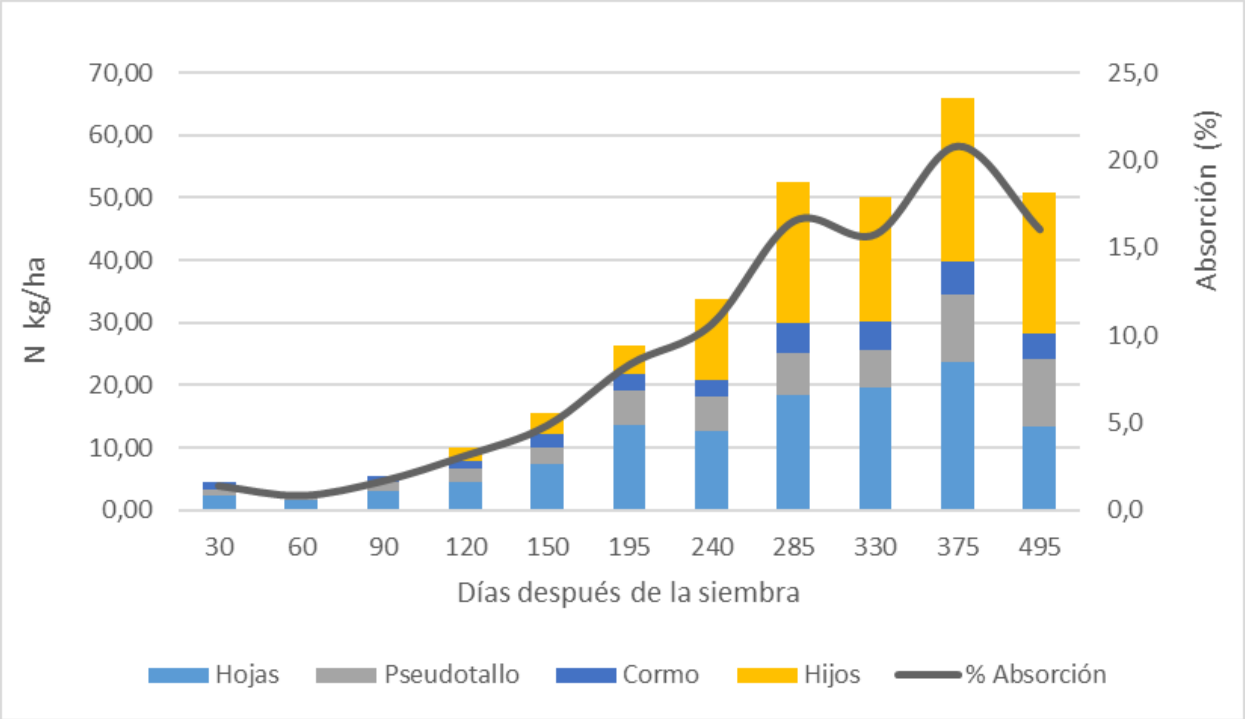

Figure 4. Nitrogen absorption curve in abacá cultivation (M. textilis) in the Guácimo area, Limón, Costa Rica

Phosphorus absorption showed a similar behavior to nitrogen, being low from planting to 120 DAP and then starting an exponential curve until 375 DAP. The organ with the highest phosphorus absorption in the mother plant was the pseudostem; and with the appearance of the suckers at 240 DAP, it was observed that they required a higher consumption of phosphorus. By the end of the crop, the total phosphorus absorption was 50 kg/ha (Figure 6).

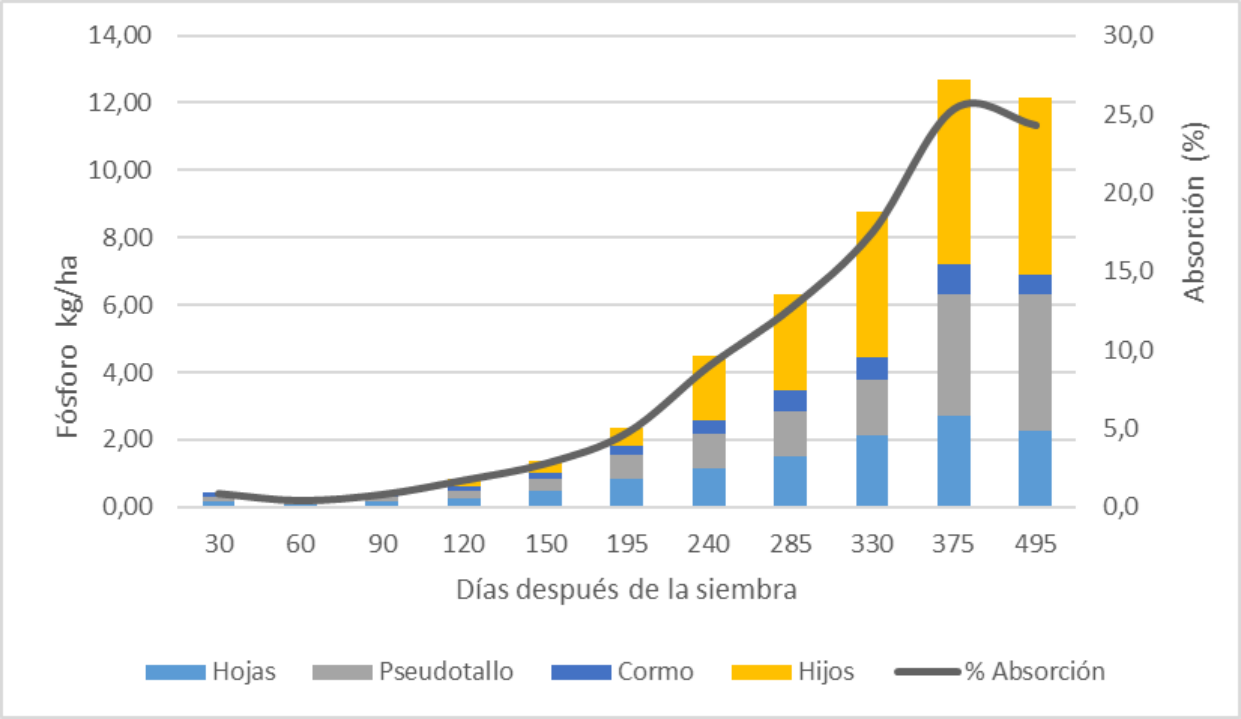

Figure 5. Phosphorus absorption curve (P2O5) in abacá cultivation (M. textilis) in the Guácimo area, Limón, Costa Rica

Potassium was the element with the highest absorption in the plant and suckers of abacá. By the end of the trial, 1033 kg/ha of potassium were absorbed, consuming 70% of these during the last 210 days of the crop. The results were directly related to the biomass gain of the crop. This factor was determinant towards the end of the crop due to the appearance of the suckers, who correspond to the following harvests (Figure 7).

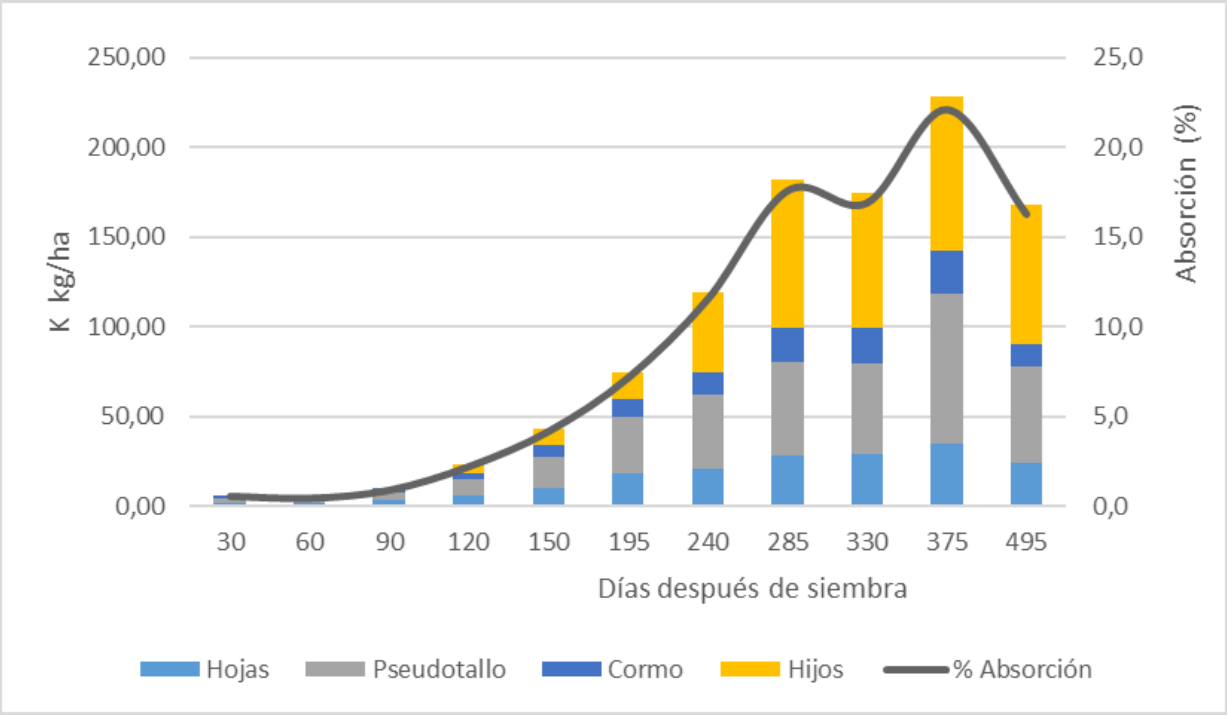

Figure 6. Potassium absorption curve (K2O) in abacá cultivation (M. textilis) in the Guácimo area, Limón, Costa Rica

Similarly to the previous elements, the amount of calcium absorbed was directly related to the growth of the plant and its phenological stages. Before 120 DAP, during the establishment stage, the absorption was low. With the beginning of the vegetative growth stage, calcium consumption increased and continued until harvest. At the time of crop harvest, the absorption was 169 kg/ha, significantly increasing after 240 DAP (Figure 8).

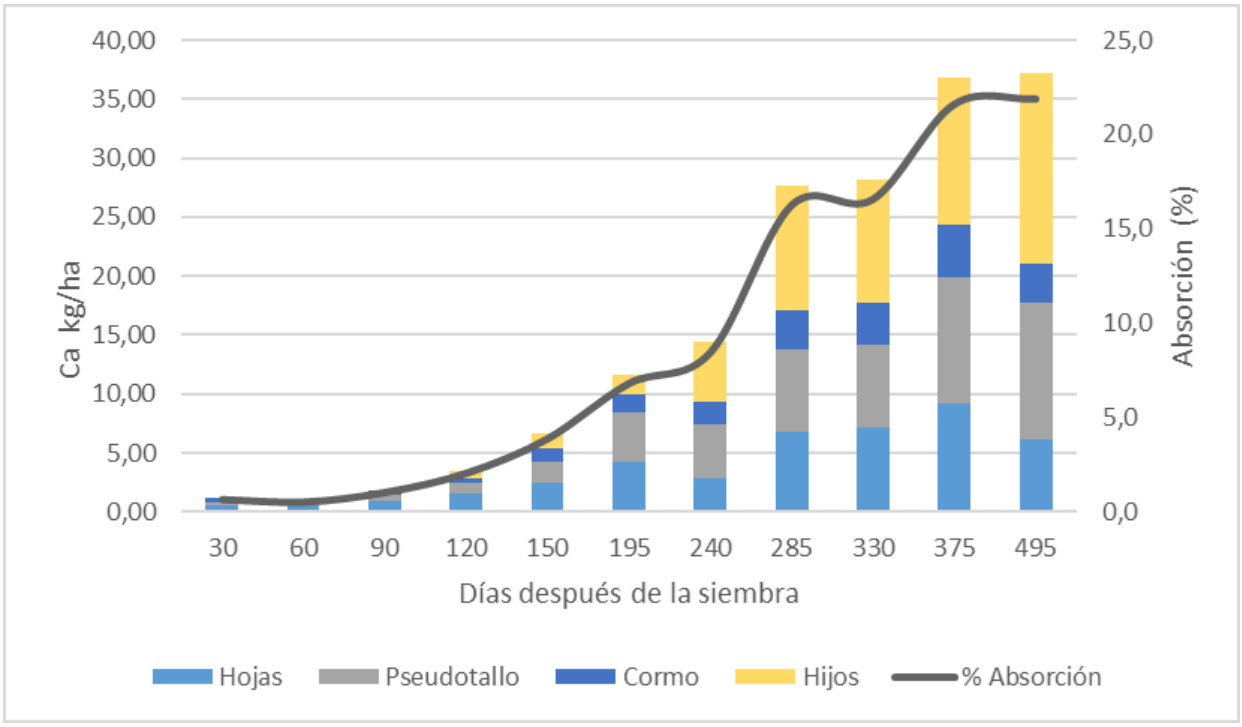

Figure 7. Calcium absorption curve (CaO) in abacá cultivation (M. textilis) in the Guácimo area, Limón, Costa Rica

In the case of magnesium, the total amount absorbed was 45.8 kg/ha, showing a significant increase in the curve starting from 120 days after planting (Figure 9).

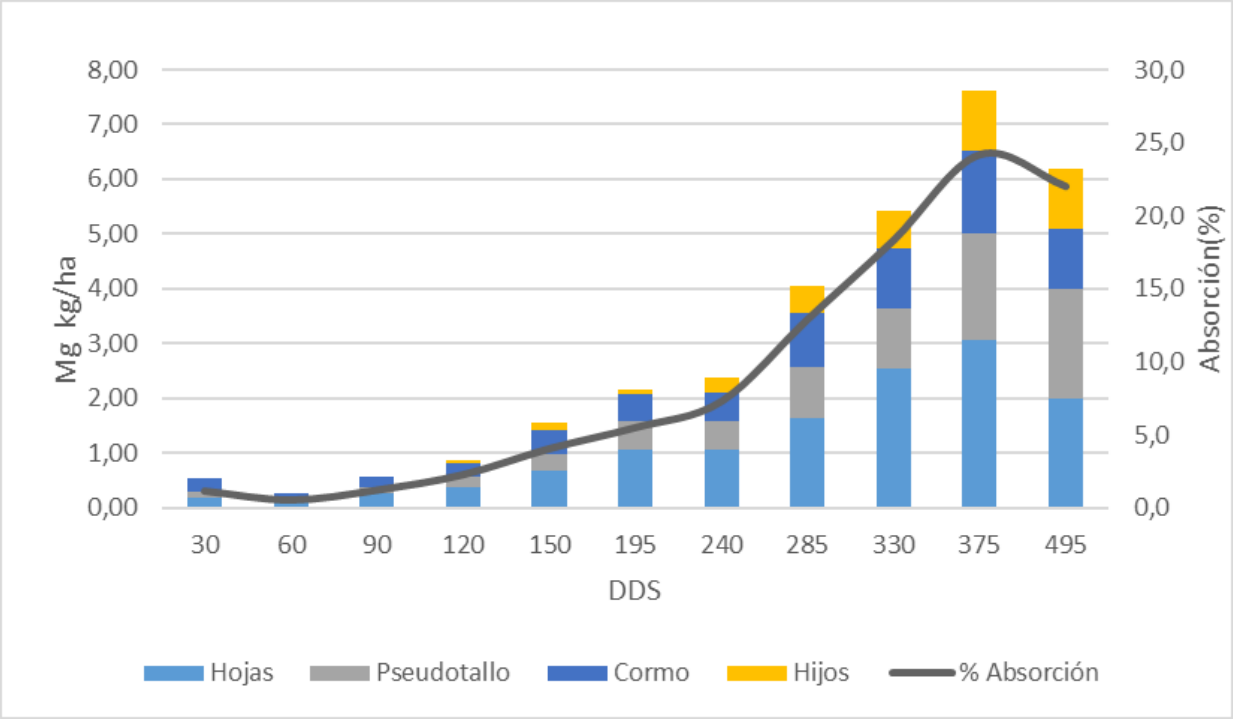

Figure 8. Magnesium absorption curve (MgO) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

The total amount of sulfur absorbed by the mother plant and suckers was 33.4 kg/ha, with 75% of this occurring after 285 days (Figure 10).

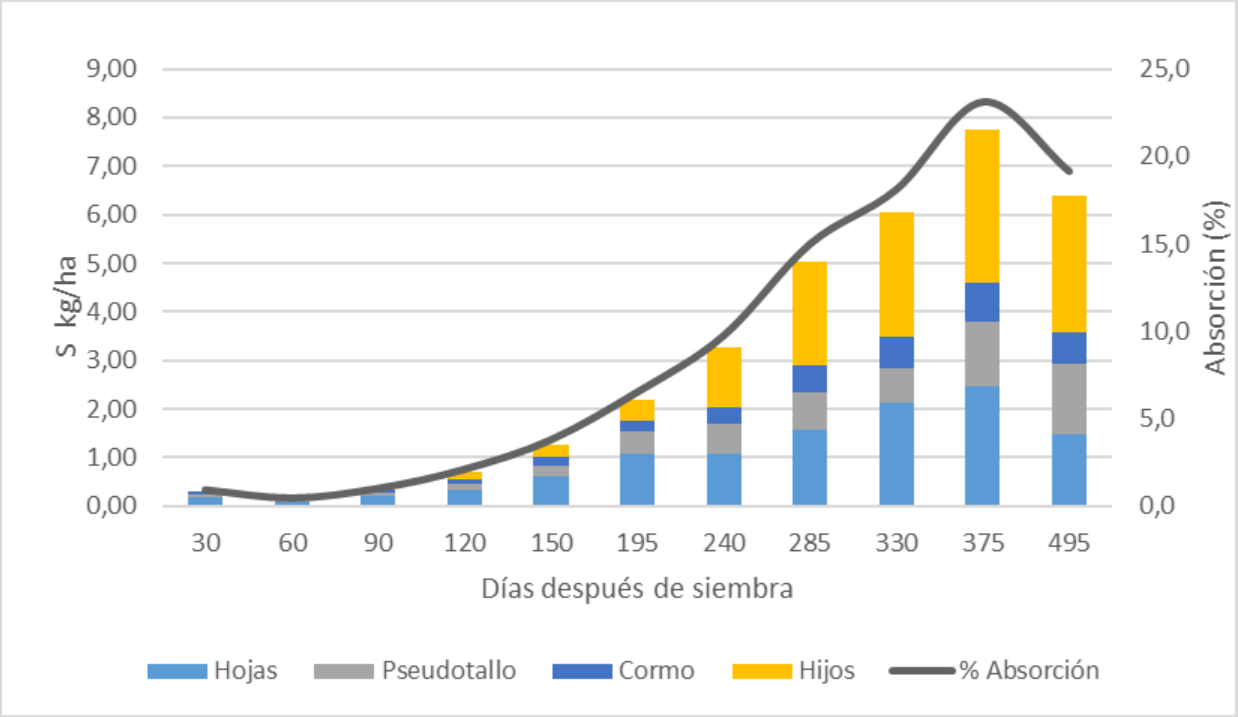

Figure 9. Sulfur absorption curve (SO4) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

In the case of micronutrients (Zn, Fe, Cu, and B), their absorption was closely related to the growth and phenological stage of the crop, starting with a low absorption stage during establishment, followed by a slight increase up to 240 DAP (during the vegetative growth stage), and later the stages of highest consumption were observed with the production of suckers and growth of the mother plant's pseudostem (Figure 11, Figure 12, Figure 13, Figure 14).

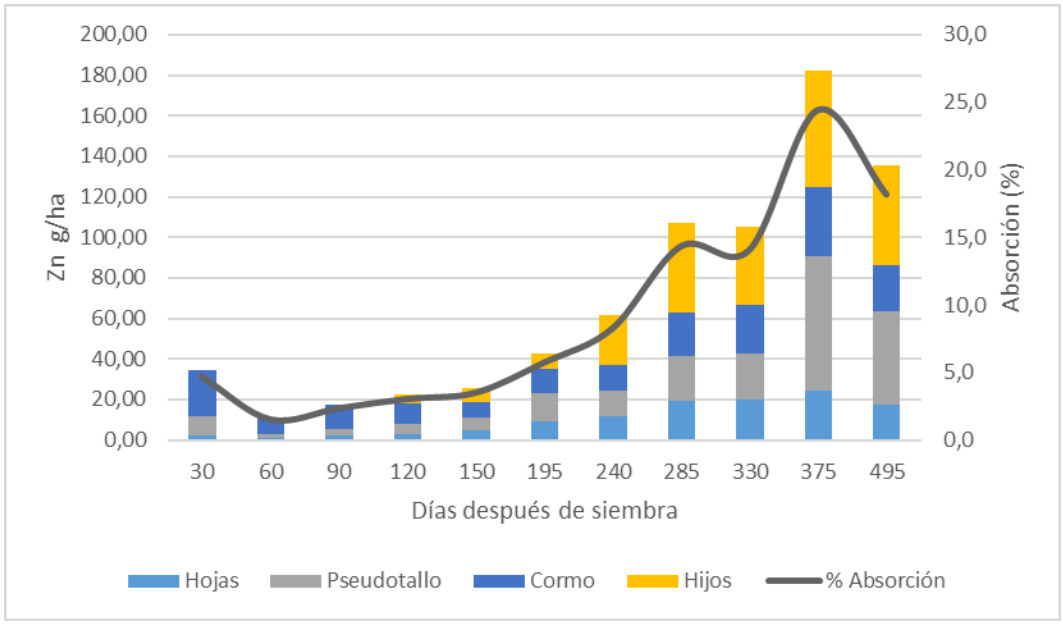

Figure 10. Zinc absorption curve (Zn) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

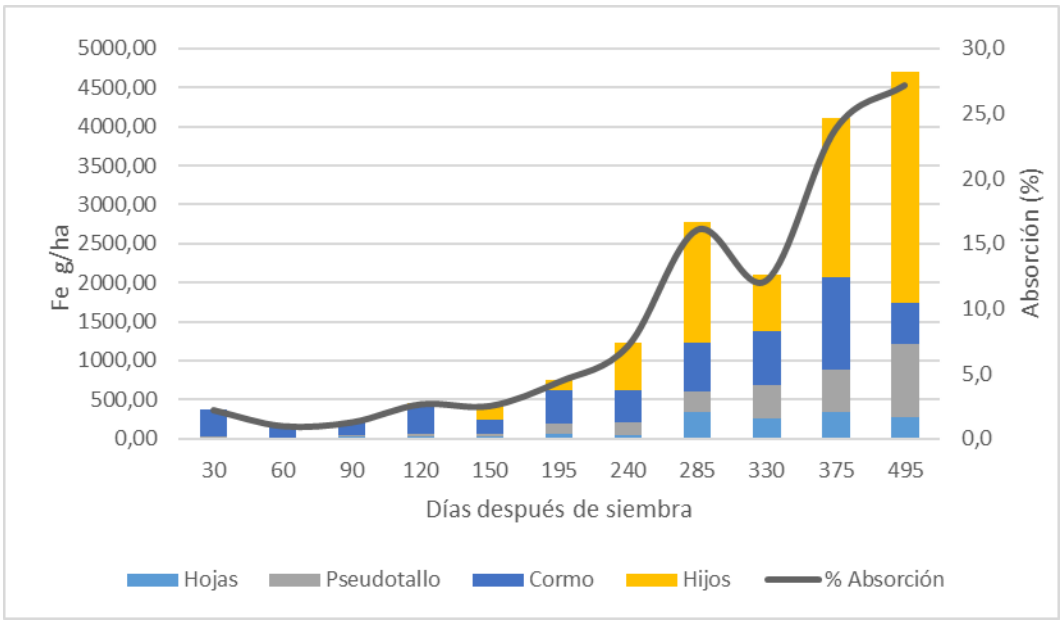

Figure 11. Iron absorption curve (Fe) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

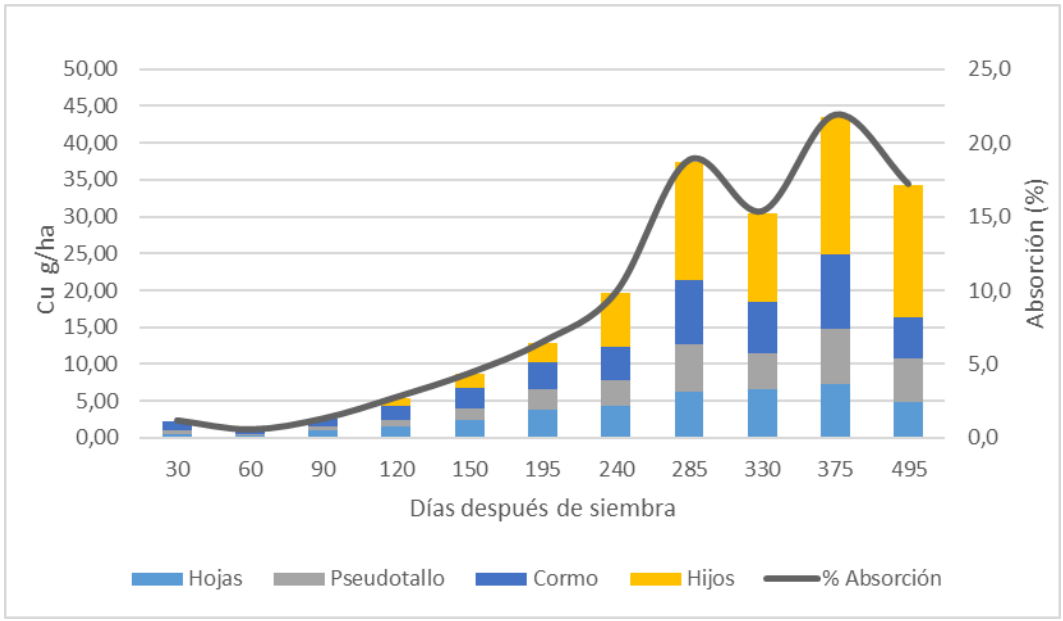

Figure 12. Copper absorption curve (Cu) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

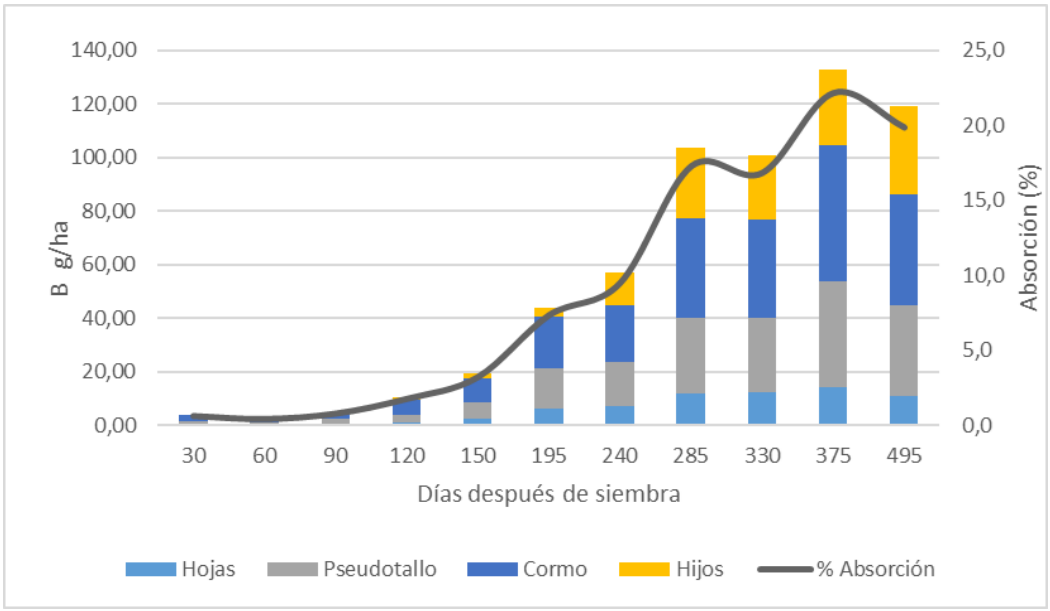

Figure 13. Boron absorption curve (B) in abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

E.3. TOTAL TRACTION IN ABACÁ CULTIVATION (*M. TEXTILIS*)

The nutritional absorption curves were influenced by the growth of the plantation and the phenological stage of the crop. The large number of suckers produced by the abacá plant made this a highly important stage in the development of the plantation during its first harvest. Proper maintenance of these suckers ensured good yield during subsequent harvests.

Table 4 shows the total amounts of nutrients absorbed by the mother plant and suckers during their growth until harvest.

Table 6. Total absorption of the mother plant and sucker throughout the production cycle of the abacá *(M. textilis)* crop

Nutrient	Absorbtion (kg o g*/ha)		
	Mother plant	Sucker	Mother + Sucker
N	203,56	114,42	317,98
P_20_5	29,03	20,93	49,96
K_2O	637,69	396,14	1033,82
CaO	111,61	58,33	169,94
MgO	27,7	18,13	45,83
SO_4	20,68	12,74	33,42
Fe*	1739	1830	3569,00
Cu*	16,33	17,87	34,1
Zn*	86,21	49,35	135,5
Mn*	429,50	359,20	788,7
B*	86,35	32,89	119,24

The element with the highest absorption was potassium, followed by nitrogen and calcium, all showing high absorption after 240 DAP (days after planting) (Table 6 and Figure 15).

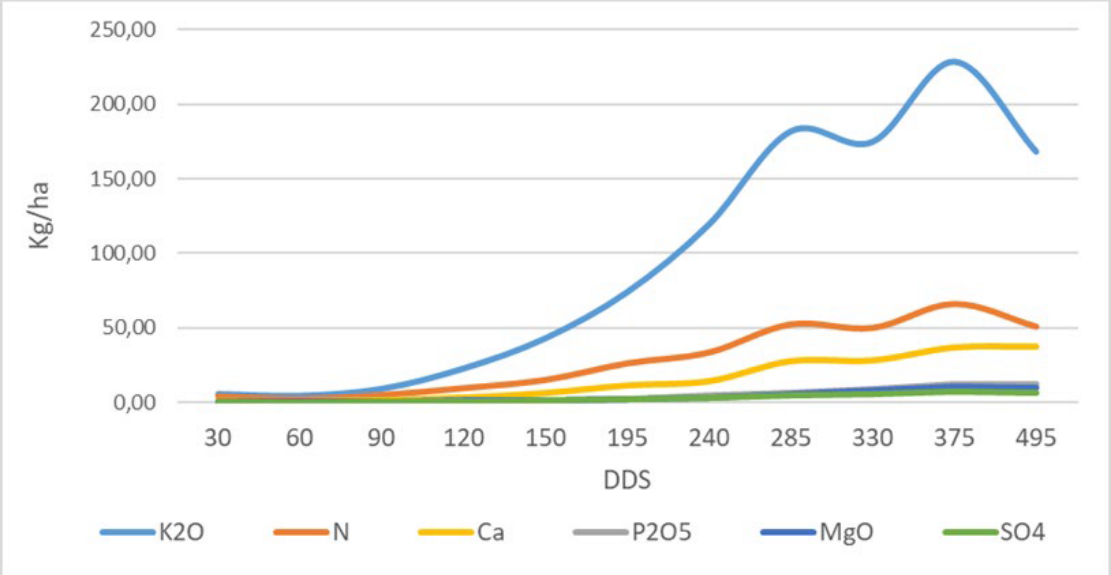

Figure 14. Absorption curve of macronutrients during the development of abacá cultivation *(M. textilis)* in the Guácimo area, Limón, Costa Rica

E.4. FERTILIZATION AND YIELD

The nutritional management of the abacá plantation was based on granular fertilizers. Three cycles were carried out during the development of the crop until 240 DAP. Table 5 details the nutritional program used during the trial.

The commercial harvest of the fiber in the plantation began on March 20, 2023, and concluded on May 17, 2023. There were five commercial deliveries of harvested fiber from the experimental area, which was 5100 m2 in size. The distribution of the production quality was 80.4% in first quality and 19.6% in second quality (Table 8).

Table 7. Fertilization performed during the trial for the development of the nutritional absorption curve and growth of the abacá crop *(M. textilis)*

Fertilization package and yield						
Dosis/plant	**Source**	**kg/ha**	**N**	**P**	**K**	**Time of application (dds)**
100 g/plant	10-30-10	111	11,1	33,3	11,1	0
50 g/plant	Urea (46% N)	56	25,3			30
100 g/plant	18-5-15	111	19,98	5,55	16,65	120
100 g/plant	18-5-15	111	19,98	5,55	16,65	240
TOTAL			**76,36**	**44,4**	**44,4**	

Note: A foliar multi-mineral fertilizer was applied at 22 and 35 DAP.

Table 8. Yield obtained in the experimental plot of abacá *(M. textilis),* Guácimo, Limón

		Experimental Area (5100 m^2)			Yield/ha		
Harvest	**Date**	**First quality (kg)**	**Second quality (kg)**	**Total (kg)**	**First quality (kg)**	**Second quality (kg)**	**Total (kg)**
1	20/3/2023	483,32	113,94	597,26	947,69	223,41	1171,10
2	30/3/2023	459,62	112,32	571,94	901,22	220,24	1121,45
3	18/4/2023	844,44	202,70	1047,14	1655,76	397,45	2053,22
4	28/4/2023	597,20	149,80	747,00	1170,98	293,73	1464,71
5	17/5/2023	878,38	217,28	1095,66	1722,31	426,04	2148,35
General Total:		3262,96	796,04	4059,00	6397,96	1560,86	7958,82
					80,4%	19,6%	

F. CONCLUSIONS

1) Four stages of development were observed in the abacá crop: establishment (0 to 120 DAP), vegetative growth (120 to 240 DAP), production of suckers (240 to 330 DAP), and pseudostem growth (330 DAP to harvest).
2) Abacá plants maintained continuous growth until harvest (height and circumference).
3) The main elements absorbed by the plants were: K>N>Ca>P>Mg>S as macronutrients; and Fe>Mn>Zn>B>Cu as micronutrients.
4) The peak of general extraction was observed at 375 DAP, with a large amount of biomass from the suckers during the first harvest.
5) The percentage of absorption in the stage prior to 240 DAP varied between 20 and 30% depending on the element, thereafter, the remaining 70 to 80% was consumed.
6) The organ with the highest absorption was the pseudostem, up until approximately 240 to 280 DAP, when the suckers started to be the organ with the highest absorption.

G. RECOMMENDATIONS

1) Carry out at least one granular application around 300 days after planting (DAP) (nitrogen and potassium source), always assessing its response in production.
2) If possible, split the application doses, increasing the doses at ages later than 240 DAP.
3) Incorporate minor elements in granular and/or foliar fertilizations.
4) Include sources of calcium and phosphorus in the fertilization after 300 DAP, expecting to see the results in the plants of the second harvest.
5) Analyze the management of harvest waste (fragmentation and distribution in the field).
6) Evaluate the alternative of different suckering techniques, as fewer suckers will result in lower nutritional and energy consumption.

H. BIBLIOGRAPHICAL REFERENCES

Bertsch, F. 2003. Absorción de nutrimentos por los cultivos. ACCS. San José, Costa Rica. 307 p.

Cabalceta, G., Saldias, M., Alvarado, A. 2005. ABSORCIÓN DE NUTRIMENTOS EN EL CULTIVAR DE PAPA.
Agronomía Costarricense 29(3): 107-123.

Morales, C. 2020. Origen, historia natural y usos de las plantas introducidas en Costa Rica, UNED Research Journal. San José, Costa Rica. 12: (2).

Organización de las Naciones Unidad para la Alimentación y la Agricultura (FAO). 2021. Fibras del Futuro. Abacá. Consultado el: 26 de octubre de 2021. Disponible en: https://www.fao.org/economic/futurefibres/fibres/abaca0/es/

Programa Biodiversidad y negocios. América Central y República Dominicana. Iniciativa de Abacá sostenible: Produciendo fibra sostenible desde el sureste asiático hasta Centroamérica.

Sambonino, B., Salavarría, J., Mieles, J., Mata, M. 2017. ANALISIS DEL MERCADO INTERNACIONAL DE LA FIBRA DE ABACÁ, SU OFERTA EXPORTABLE HACIA REINO UNIDO Y SU APORTE EN EL CAMBIO DE
LA MATRIZ PRODUCTIVA. Segundo Congreso Internacional en administración de negocios internacionales. Universidad Pontificia Bolivariana.

Sancho, H. 1999. Curvas de absorción de nutrientes: importancia y uso en los programas de fertilización.
Informaciones Agronómicas N 36 (INPOFOS). San José, Costa Rica. 36: 011-13.

I. ANEXXES

Annex 1. Atmospheric weather conditions during the development of the trial.

Year	Week of the year evaluation	Precipitation (mm)	Average Temperature (°C)	Average relative humidity (%)
2021	45	110,81	25,4	92,2
	46	76,8	24,8	93,0
	47	14,4	25,9	90,0
	48	46,8	24,9	92,3
	49	203,2	24,3	96,4
	50	45,2	25,4	91,0
	51	87,8	25,4	92,9
	52	82,6	24,4	94,9
2022	1	1,2	27,8	78,7
	2	0,4	27,3	79,1
	3	1,2	27,4	80,1
	4	2,4	28,1	72,8
	5	0,2	28,0	75,5
	6	14,6	28,2	76,0
	7	38,0	26,1	84,8
	8	3,8	28,0	73,0
	9	20,4	27,0	79,0
	10	11,4	28,5	75,8
	11	6,0	28,8	78,0
	12	10,2	27,7	81,2
	13	1,0	28,7	78,8
	14	59,8	28,4	84,0
	15	7,6	27,6	86,0
	16	0,6	29,1	76,6
	17	7,6	26,8	87,9

18	9,8	25,1	86,3

	19	41,6	27,5	81,5
	20	24,0	28,0	87,7
	21	16,6	28,6	85,3
	22	30,8	26,4	89,5
	23	109,0	26,4	89,3
	24	160,0	25,8	91,1
	25	130,6	25,9	90,1
	26	91,5	25,4	87,6
	27	97,6	25,6	84,7
	28	13,0	26,7	89,0
	29	31,0	26,6	88,9
	30	28,0	26,0	89,3
	31	91,8	25,5	91,1
	32	23,6	26,5	90,1
	33	23,7	27,1	85,9
	34	91,6	26,6	89,1
	35	26,8	26,3	92,1
	36	6,4	26,7	87,6
	37	9,2	26,7	86,7
	38	2,6	26,5	86,9
	39	104,6	26,3	88,6
	40	79,0	25,5	85,7
	41	10,8	26,3	90,0
	42	12	26,6	89,3
	43	0,8	26,8	91,4
	44	70,6	26,1	89,1
	45	60,44	26,1	92,1
	46	74	24,8	87,6
	47	22,4	25,7	86,7
	48	56,613	25,5	86,9

	49	20	24,8	88,6
	50	40	25,0	89,7
	51	54	24,7	89,1
	52	0,4	25,2	92,1
2023	1	23	24,6	88,8
	2	5,1	25,3	82,7
	3	8,65	25,2	83,1
	4	5,1	26,1	82,3
	5	5,7	26,1	78,1
	6	9,9	25,8	84,5
	7	12,7	25,6	84,5
	8	6,6	26,4	79,3
	9	5,35	25,9	83,5
	10	8,5	25,0	86,3
	11	0	27,1	81,1
	12	8,9	26,9	78,9
	13	7,35	25,3	83,6
	14	19,55	24,3	90,1
	15	9,3	25,1	85,4
	16	0,9	25,4	81,7
	17	0	25,9	80,9
	18	0	26,8	84,4
	19	6,35	26,4	90,5
	20	3,55	27,0	87,6
	21	1,15	27,0	84,7
	22	15,35	27,0	86,8
	23	29,2	26,5	88,2
	24	29,2	26,7	87,7
	25	17,65	26,3	89,6
	26	12,95	26,4	90,2

	27	75,8	26,5	88,6
	28	6,85	26,2	91,0

Source: Biotech Meteorological Station. Guácimo, Limón.

Annex 2. Analysis of the complete chemical content and pH of the soil at the Biotech experimental station.

PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN SOIL AND FOLIAR LABORATORY

TEST REPORT RE-R0

REPORT Nº: 79631

1 (

USER: BIOTECH CR GRM S.A.

RESPONSIBLE: EMAIL: TELEPHONE: STEFANY REDONDO ROMERO Phytolab@laboratorio biotech.com, sredondo@laboratori obiotech.com 2552-8645, 2573-8170

PROVINCE: LIMÓN

ANALYSIS: QC, CN19/11/2021

RECEPTION DATE:

CANTON: AREA GUÁCIMO RÍO JIMÉNEZ

REPORT ISSUANCE: 26/11/2021

CROP: ABACA

PAGE: Nº OF TOTAL SAMPLES 1 1/2

SOIL CHEMICAL ANALYSIS

Extracting Solution: KCl-Olsen Modified		pH	cmol(+)/L					%	mg/L				
		H_2O	ACIDITY	Ca	Mg	K	CICE	SA	P	Zn	Cu	Fe	Mn
~~USER ID~~	~~ID LAB~~	~~5,5~~	~~0,5~~	~~4~~	~~1~~	~~0,2~~	~~5~~		~~10~~	~~3~~	~~1~~	~~10~~	~~5~~
BIOTECH TRIAL	S-21-06570	5,7	0,37	5,75	2,00	0,80	8,92	4	21	1,1	4	94	12

----------LAST LINE----------

The values below each element correspond to the general Critical Levels for the used extraction solution

CICE=Effective Cation Exchange Capacity=Acidity+Ca+Mg+K

SA=Acidity Saturation Percentage=(Acidity/CICE)*100 SA

B.Q. Marianela Blanco M.
N.I. 2468
Quality Management

Ing. Agr. Michael González A.
N.I. 7827
Technical Management

1. The units are expressed on a dry basis, in mass/volume. 2. Procedure: pH and EC in water 10:25; Acidity, Al, Ca, and Mg with 1M KCl 1:10; P,K,Zn,Fe,Mn, and Cu with Modified Olsen pH 8.5 (0.5 N NaHCO3, 0.01M EDTA, Superfloc 127) 1:10; B and S with 0.008M Ca(H2PO4)2·H2O 10:25. Acidity determined by titration with NaOH and Al with HCl; P and S by Colorimetry with the Flow Injection Analyzer (FIA) and the rest of the elements by Atomic Absorption Spectrophotometry. Total C and N by dry combustion in Autoanalyzer. 3. Sampling is the user's responsibility. 4. The results refer only to the tested samples. 5. The custody time of the samples is 45 days from the entry of the sample. 6. The original signed and sealed Test Report is valid and printed upon explicit request of the user; when the user requests the report to be sent by email or fax, it releases the Laboratory from safeguarding the integrity and confidentiality of its results.

Annex 3. Organic matter analysis of the soil at the Biotech experimental station PPhy-107-21.

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN SOIL AND FOLIAR LABORATORY

TEST REPORT

REPORT Nº: 79631

E - R 0 1 (y 3)

USER: BIOTECH CR GRM S.A.

RESPONSIBLE: EMAIL TELEPHONE: STEFANY REDONDO ROMERO
Phytolab@laboratorio
biotech.com,
sredondo@laboratori
obiotech.com
2552-8645,
2573-8170

PROVINCE: LIMÓN GUÁCIMO
CANTON:

ANALYSIS: QC,CN
RECEPTION DATE: 19/11/2021
REPORT ISSUANCE: 26/11/2021

AREA RÍO JIMÉNEZ

Nº OF TOTAL SAMPLES: 1

CROP: ABACA

SOIL CHEMICAL ANALYSIS

		mS/cm	%		Relation
USER ID	ID LAB	CE 1,5	C	N	C/N
BIOTECH TEST	S-21-06570	0,1	3,09	0,38	8,1

----------LASR LINE----------

OBSERVATION: The total % C and N were determined with the C/N Autoanalyzer by dry combustion. The total % C values correlate very well (R2≥0.95) with the % of organic matter (MO). If you want to estimate the value of the % MO from the % C total determined with this methodology, multiply the % C total by 1.43.

B.Q. Marianela Blanco M.
N.I. 2468
Quality Management

Ing. Agr. Michael González A.
N.I. 7827
Technical Management

1. Sampling is the user's responsibility. 2. The results refer only to the tested samples. 3. The custody time of the samples is 45 days from the entry of the sample. 4. The valid Test Report is the original, signed, and sealed, printed upon explicit request of the user; when the user requests the report to be sent by email or fax, it releases the Laboratory from safeguarding the integrity and confidentiality of its results.

Annex 4. Texture and gravimetric moisture analysis of the soil at the Biotech experimental station. PPhy-107-21

CENTER FOR AGRONOMIC RESEARCH NATURAL RESOURCES LABORATORY
TEST REPORT

REPORT Nº : **77947**
USER: SUBCLIENT RESPONSIBLE: EMAIL TELEPHONE:

BIOTECHCRGRM, S.A. PINEAPPLE TEST
STEFANY REDONDO ROMERO
facturacion@laboratoriobiotech.com; Phytolab@laboratoriobiotech.com; sredondo@laboratoriobiotech.com 2552-8645, 2552-8645, 2573-8170

ANALYSIS: TEXT, HG,

PROVINCIE CANTON: AREA CROP:

LIMÓN
GUACIMO
RÍO JIMÉNEZ
NO CROP

RECEPTION DATE: 21/06/2021
REPORT ISSUANCE: 05/07/2021
Nº OF TOTAL SAMPLES: 1
PÁGE: 1/1

TEXTURE AND GRAVIMETRIC MOISTURE ANALYSIS IN SOILS						
		%				%
USER ID	ID LAB	SAND	LIMO	CLAY	Textural	GRAVIMETRIC MOISTURE
BIOTECH PINEAPPLE TEST	RN-21-00792	50	25	25	SANDY LOAM	37

Ing. Agr. Rafael Mata Chinchilla M.Sc.
NATURAL RESOURCES LABORATORY COORDINATOR

1. Results expressed as percentages. 2. Texture procedure according to CIA-SC09-03-P02 Determination of Soil Texture by the Bouyoucos Hydrometer Method. 3. Sampling is the user's responsibility. 4. The results refer only to the tested samples. 5. The custody time is 45 days from the entry of the sample. 6. The valid Test Report is the original, signed and sealed; when the user requests the report to be sent by email or fax, it releases the Laboratory from safeguarding the integrity and confidentiality of its results.

Annex 5. First foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

Laboratorio de Ensayo
Alcance de Acreditación N° LE-033
Acreditado a partir de: 2006.06.12
Alcance disponible en www.eca.or.cr

REPORT Nº: **79910**
USER: BIOTECH CR GRM S.A.

RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 2573-8170

PROVINCE: LIMON
CANTON: GUACIMO
AREA: RIO JIMENEZ
CROP: ABACA

ANÁLYSIS: QC,B,S, PF,PS
RECEPTION DATE: 09/12/2021
REPORT ISSUANCE: 15/12/2021
Nº OF TOTAL SAMPLES: 9
PAGE: 1/1

ANÁLISIS QUÍMICO FOLIAR

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST LOTE - A - CORM	P-21-04130	1,80	0,20	0,57	0,52	2,32	0,13	7031	26	425	303	20	471,6	53,3	89
BIOTECH TEST LOTE - A - PSEUDOSTEM	P-21-04131	2,01	0,25	0,64	0,20	4,90	0,13	521	9	112	370	13	553,9	43,6	92
BIOTECH TEST LOTE - A - LEAVES	P-21-04132	3,26	0,21	0,72	0,26	2,84	0,21	144	7	31	649	8	354,0	62,6	82
BIOTECH TEST LOTE - B - CORM	P-21-04133	2,01	0,21	0,50	0,31	2,75	0,14	4104	14	403	193	16	439,6	51,4	88
BIOTECH TEST LOTE - B - PSEUDOSTEM	P-21-04134	2,36	0,29	0,48	0,18	5,71	0,13	307	8	182	296	11	626,5	43,0	93
BIOTECH TEST LOTE - B - LEAVES	P-21-04135	3,50	0,24	0,80	0,29	2,95	0,27	133	9	42	732	8	309,1	55,5	82
BIOTECH TEST LOTE - C - CORM	P-21-04136	2,08	0,26	0,57	0,45	2,67	0,16	5392	21	699	268	19	434,2	49,2	89
BIOTECH TEST LOTE - C - PSEUDOSTEM	P-21-04137	2,29	0,29	0,71	0,20	4,80	0,12	394	12	183	284	12	548,2	41,4	92
BIOTECH TEST LOTE - C - LEAVES	P-21-04138	3,29	0,23	0,81	0,26	2,84	0,23	126	9	39	668	8	352,1	63,2	82

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 6. Second foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

80051
BIOTECH CR GRM S.A.

REPORT Nº:
USER:

SOIL AND FOLIAR LABORATORY

TEST REPORT RE-R01

(V 3)

RESPONSIBLE: EMAIL TELEPHONE:

STEFANY REDONDO ROMERO Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com 25528645, 25730170

ANALYSIS: QC,B,S, PF,PS

PROVINCIA: LIMÓN

RECEPTION DATE: 13/01/2022

CANTON: GUÁCIMO

REPORT ISSUANCE 19/01/2022

AREA CROP RÍO JIMÉNEZ
SAMPLES: 9
ABACA

Nº OF TOTAL

PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID		IDLAB	% mass						mg/kg					g		%
			N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST	- A - CORM	P-22-00102	1,52	0,14	0,52	0,27	2,22	0,08	3252	15	226	236	14	493,0	70,8	86
BIOTECH TEST	- A - PSEUDOSTEM	P-22-00103	1,90	0,17	0,66	0,17	6,35	0,08	173	5	74	321	13	495,3	30,6	94
BIOTECH TEST	- A - LEAVES	P-22-00104	3,04	0,19	1,16	0,29	4,09	0,18	129	7	26	882	9	462,5	87,7	81
BIOTECH TEST	- B - CORM	P-22-00105	1,91	0,14	0,63	0,22	2,54	0,11	1896	13	213	279	12	492,2	67,4	86
BIOTECH TEST	- B - PESUDOSTEM	P-22-00106	2,00	0,13	0,64	0,10	5,78	0,07	116	4	64	303	12	493,9	31,3	94
BIOTECH TEST	- B - LEAVES	P-22-00107	3,44	0,20	1,06	0,25	4,03	0,20	214	8	25	1132	9	396,3	71,1	82
BIOTECH TEST	- C -CORM	P-22-00108	1,59	0,16	0,59	0,31	3,34	0,10	4218	18	230	371	16	494,0	69,1	86
BIOTECH TEST	- C - PSEUDOSTEM	P-22-00109	2,07	0,18	0,68	0,14	7,85	0,10	327	7	52	369	14	494,0	30,8	94
BIOTECH TEST	- C - LEAVES	P-22-00110	3,19	0,19	0,97	0,24	4,17	0,18	318	9	22	970	10	487,9	85,5	82

----------LAST. LINE----------

OBSERVATION: OT#007 *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 7. Second dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº: **80052**
USER: BIOTECH CR GRM S.A.

RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 2573-8170

PROVINCE: LIMON
CANTON: GUACIMO
AREA RIO JIMENEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 13/01/2022
REPORT ISSUANCE: 19/01/2022
Nº OF TOTAL SAMPLES: 6
PAGE: 1/1

FOLIAR CHEMICAL ANALYSIS

USER ID		IDLAB	g		%
			P.Fresh**	P.Dry**	Hum**
BIOTECH TEST -	A - CORM	P-22-00111	494,4	70,8	86
BIOTECH TEST -	A - PSEUDOSTEM	P-22-00112	494,7	31,4	94
BIOTECH TEST -	A - LEAVES	P-22-00113	469,1	88,1	81
BIOTECH TEST	B - CORM	P-22-00114	491,3	61,6	87
BIOTECH TEST -	B - PSEUDOSTEM	P-22-00115	494,3	31,9	94
BIOTECH TEST -	B - LEAVES	P-22-00116	405,5	78,4	81

----------LAST LINE----------

OBSERVATION: OC#008

Annex 8. Third foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

ilac-MRA ECA. ENTE COSTARRICENSE DE ACREDITACIÓN
Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**80427**
USER:	BIOTECH CR GRM S.A.
SUBCLIENT	ABACA TEST
RESPONSABLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE:	2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	GUACIMO
AREA	RIO JIMENEZ
CROP:	ABACA
ANALYSIS:	QC,B,S, PF,PS
RECEPTION DATE:	11/02/2022
REPORT ISSUANCE:	16/02/2022
Nº OF TOTAL SAMPLES:	9
PAGE:	1/1

FOLIAR CHEMICAL ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
G1- A-CORM	P-22-00611	1,78	0,15	0,54	0,38	3,14	0,11	2512	20	291	318	15	509,2	55,8	89
G1- A-PSEUDOSTEM	P-22-00612	1,70	0,15	0,62	0,20	4,77	0,09	453	6	61	260	12	490,1	32,3	93
G1- A-LEAVES	P-22-00613	3,46	0,19	1,04	0,38	2,80	0,22	242	10	22	1424	8	489,4	88,1	82
G1- B-CORM	P-22-00614	1,66	0,15	0,51	0,30	3,61	0,10	3419	19	180	243	15	524,1	50,4	90
G1- B-PSEUDOSTEM	P-22-00615	1,74	0,16	0,70	0,14	6,62	0,09	299	6	43	151	12	492,9	29,0	94
G1- B-LEAVES	P-22-00616	3,62	0,22	0,99	0,27	3,64	0,23	186	12	22	887	8	489,0	74,2	85
G1- C-CORM	P-22-00617	1,39	0,18	0,57	0,38	2,94	0,10	10398	34	200	490	27	495,8	57,7	88
G1- C-PSEUDOSTEM	P-22-00618	1,96	0,17	0,83	0,15	6,80	0,12	421	8	44	192	14	489,8	28,8	94
G1- C-LEAVES	P-22-00619	3,50	0,19	1,17	0,28	3,76	0,23	229	12	21	974	8	489,0	77,6	84

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 9. Third dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

80428

BIOTECH CR GRM S.A. TEST ABACA

REPORT Nº:

USER: SUBCLIENT

SOIL AND FOLIAR LABORATORY

TEST REPORT

RESPONSIBLE: EMAIL TELEPHONE:

STEFANY REDONDO ROMERO
Phytolab@laboratoriobiotech.com,
sredondo@laboratoriobiotech.com
2552-8645,
8701-2286

PROVINCE: LIMÓN

ANALYSIS: PF,PS

RECEPTION DATE: 11/02/2022

CANTON: GUÁCIMO

REPORT ISSUANCE 16/02/2022

AREA CROP:

RÍO JIMÉNEZ
TOTAL SAMPLES: 6
ABACA

Nº OF

PAGE: 1/1

FOLIAR CHEMICAL ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh**	P.Dry**	Hum**
G2 - A-CORM	P-22-00620	518,6	64,5	88
G2 - A-PSEUDOSTEM	P-22-00621	489,1	31,3	94
G2 - A-LEAVES	P-22-00622	492,6	85,2	83
G2 - B-CORM	P-22-00623	502,3	49,3	90
G2 - B-PSEUDOSTEM	P-22-00624	492,5	28,1	94
G2 - B-LEAVES	P-22-00625	505,6	76,5	85

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 10. Fourth foliar chemical analysis of abacá cultivation. PPhy-107-21.

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

REPORT Nº: **80748**

USER: SUBCLIENT RESPONSIBLE: BIOTECH CR GRM S.A. N°028-22
STEFANY REDONDO ROMERO

SOIL AND FOLIAR ANALYSIS

TEST REPORT

RE-R01

EMAIL TELEPHONE: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com2552-8645, 8701-2286

ANALYSIS: QC,B,S, PF,PS

PROVINCE: LIMÓN

CANTON: POCOCÍ

RECEPTION DATE: 10/03/2022

REPORT ISSUANCE: 16/03/2022

AREA CROP: JIMÉNEZ

SAMPLES: 9

ABACA

Nº OF TOTAL

PAGE: 1/1

FOLIAR CHEMICAL ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST - A-CORM	P-22-01000	1,53	0,14	0,62	0,33	2,95	0,10	3414	21	150	239	30	486,1	57,4	88
BIOTECH TEST - A-PSEUDOSTEM	P-22-01001	1,49	0,18	0,61	0,20	5,73	0,10	310	7	51	192	14	493,1	29,1	94
BIOTECH TEST - A-LEAVES	P-22-01002	3,28	0,19	0,97	0,35	3,01	0,21	209	11	22	760	8	488,1	79,6	84
BIOTECH TEST - B-CORM	P-22-01003	1,54	0,13	0,51	0,23	4,26	0,10	1953	23	113	147	20	489,8	52,0	89
BIOTECH TEST - B-PSEUDOSTEM	P-22-01004	1,58	0,15	0,68	0,13	6,83	0,11	211	8	37	101	13	484,9	29,0	94
BIOTECH TEST - B-LEAVES	P-22-01005	3,03	0,17	1,17	0,23	3,85	0,22	203	9	19	628	8	478,9	76,7	84
BIOTECH TEST - C-CORM	P-22-01006	1,51	0,15	0,60	0,30	4,45	0,10	4892	26	113	208	33	489,9	53,4	89
BIOTECH TEST - C-PSEUDOSTEM	P-22-01007	1,57	0,16	0,59	0,11	7,16	0,10	160	7	39	80	12	485,9	27,4	94
BIOTECH TEST - C-LEAVES	P-22-01008	3,20	0,20	1,13	0,23	4,32	0,25	200	11	19	454	9	477,6	78,9	83

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 11. Fourth dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**80750**
USER:	BIOTECH CR GRM S.A. N°029-22
SUBCLIENT	
RESPONSIBLE:	BIOTECH CR GRM S.A.
EMAIL	Phytolab@laboratoriobiotech.com
TELEPHONE:	2552-8645
PROVINCE:	LIMON
CANTON:	POCOCI
AREA	JIMENEZ
CROP:	ABACA

ANALYSIS:	PF,PS
RECEPTION DATE:	10/03/2022
REPORT ISSUANCE:	16/03/2022
Nº OF TOTAL SAMPLES:	6
PAGE:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST - A-CORMO	P-22-01012	491,9	62,9	87
BIOTECH TEST - A-PSEUDOTALLO	P-22-01013	489,3	31,3	94
BIOTECH TEST - A-HOJAS	P-22-01014	482,6	83,9	83
BIOTECH TEST - B-CORMO	P-22-01015	490,7	57,3	88
BIOTECH TEST - B-PSEUDOTALLO	P-22-01016	485,7	28,3	94
BIOTECH TEST - B-HOJAS	P-22-01017	479,7	85,5	82

----------LAST LINE----------

Annex 12. Fifth foliar chemical analysis of abacá cultivation. PPhy-107-21.

UNIVERSIDAD DE COSTA RICA

81334

BIOTECH CR GRM S.A. ENSAYO ABACA
STEFANY REDONDO ROMERO

REPORT Nº: USER: SUBCLIENT
RESPONSIBLE:

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY
TEST REPORT RE-R0

1
(

EMAIL TELPHONE: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com 2552-8645, 8701-2286

)

PROVINCE: LIMÓN

CANTON: GUÁCIMO

AREA CROP: RÍO JIMÉNEZ ABACA

ANALYSIS: QC,B,S, PF,PS

RECEPTION DATE: 21/04/2022

REPORT ISSUANCE: 28/04/2022

SAMPLES: 12

Nº OF TOTAL

PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
GROUP 1 - A-CORM	P-22-01621	1,27	0,14	0,63	0,34	3,06	0,10	4203	22	142	251	17	487,5	54,8	89
GROUP 1 - A-PSEUDOSTEM	P-22-01622	0,86	0,12	0,53	0,13	5,33	0,07	114	4	26	142	10	484,7	36,3	93
GROUP 1 - A-LEAVES	P-22-01623	2,55	0,17	0,84	0,27	3,25	0,19	92	8	17	440	9	485,7	93,2	81
GROUP 1 - B-CORM	P-22-01624	1,24	0,12	0,64	0,22	4,37	0,10	1954	15	75	158	15	489,0	45,7	91
GROUP 1 - B-PSEUDOSTEM	P-22-01625	1,06	0,13	0,63	0,10	6,15	0,09	143	6	21	115	13	488,1	30,1	94
GROUP 1 - B-LEAVES	P-22-01626	2,72	0,16	0,87	0,23	3,91	0,21	129	9	17	298	9	483,3	76,2	84
GROUP 1 - C-CORM	P-22-01627	1,15	0,10	0,65	0,21	4,53	0,08	1022	12	47	106	12	486,7	50,8	90
GROUP 1 - C-PSEUDOSTEM	P-22-01628	0,88	0,13	0,75	0,11	6,48	0,08	149	5	22	100	14	484,5	32,1	93
GROUP 1 - C-LEAVES	P-22-01629	2,82	0,18	0,92	0,24	3,83	0,26	176	10	19	252	10	483,9	89,0	82
GROUP 3 - A-SUCKER CORM	P-22-01630	1,16	0,15	0,49	0,27	4,12	0,09	3032	18	75	188	14	485,6	55,7	89
GROUP 3 - A-SUCKER PSEUDOSTEM	P-22-01631	1,16	0,18	0,57	0,16	6,12	0,08	218	5	27	164	11	491,1	32,6	93
GROUP 3 - A-SUCKER LEAVES	P-22-01632	2,89	0,20	0,96	0,31	3,82	0,25	118	9	18	448	8	491,1	32,6	93

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 13. Fifth dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORAT(

Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

TEST REPORT

RE-R01 (V3)

REPORT Nº: **81333**

USER: BIOTECH CR GRM S.A.
SUBCLIENT: ABACA TEST
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMON
CANTON: GUACIMO
AREA: RIO JIMENEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 21/04/2022
REPORT ISSUANCE: 28/04/2022
Nº OF TOTAL SAMPLES: 12
PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh**	P.Dry**	Hum**
GROUP 2 - A-CORM	P-22-01609	476,9	66,1	86
GROUP 2 - A-PSEUDSTEM	P-22-01610	482,5	36,7	92
GROUP 2 - A-LEAVES	P-22-01611	488,3	91,0	81
GROUP 2 - B-CORM	P-22-01612	491,7	57,4	88
GROUP 2 - B-PSEUDOSTEM	P-22-01613	486,8	30,1	94
GROUP 2 - B-LEAVES	P-22-01614	471,7	82,0	83
GROUP 4 - B-SUCKER CORM	P-22-01615	488,7	54,2	89
GROUP 4 - B-SUCKER PSEUDOSTEM	P-22-01616	485,1	27,3	94
GROUP 4 - B-SUCKER LEAVES	P-22-01617	476,2	76,9	84
GROUP 4 - C-SUCKER CORM	P-22-01618	483,4	55,0	89
GROUP 4 - C-SUCKER PSEUDOSTEM	P-22-01619	481,5	29,6	94
GROUP 4 - C-SUCKER LEAVES	P-22-01620	483,8	76,8	84

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 14. Sixth foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

REPORT Nº: USER: SUBCLIENT

81949
BIOTECH CR GRM S.A. ENSAYO BIOTECH #61-22

CIUDAD DE LA INVESTIGACIÓN SOIL AND FOLIAR REPORT **TEST REPORT** RE-R01

(3)

RESPONSIBLE: EMAIL TELEPHONE:

STEFANY REDONDO ROMERO
Phytolab @laboratoriobiotech.com, sredondo @laboratoriobiotech.com
2552-8645, 8701-2286

ANALYSIS: QC,B,S, PF,PS

PROVINCE: LIMÓN

RECEPTION DATE 08/06/2022

CANTON: GUÁCIMO

REPORT ISSUANCE: 17/06/2022

AREA CROP: RÍO JIMÉNEZ
9
ABACA

Nº OF TOTAL SAMPLES:

PAGE 1/1

FOLIAR CHEMICAL ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A - CORM	P-22-02546	1,12	0,12	0,50	0,20	3,44	0,09	2433	18	67	186	17	486,3	60,3	90
A - PSEUDOSTEM	P-22-02547	0,74	0,11	0,60	0,08	4,61	0,06	200	4	27	130	12	491,0	37,7	93
A- LEAVES	P-22-02548	2,64	0,17	0,75	0,20	3,36	0,21	233	8	18	335	11	493,3	97,7	80
B- CORM	P-22-02549	1,14	0,10	0,57	0,18	4,52	0,09	1299	14	50	135	16	488,4	51,2	90
B - PSEUDOSTEM	P-22-02550	1,06	0,12	0,61	0,09	5,54	0,08	230	5	21	133	15	487,1	35,4	93
B - LEAVES	P-22-02551	2,63	0,15	0,83	0,19	3,40	0,21	95	7	16	261	12	497,8	95,6	81
C - CORM	P-22-02552	0,94	0,10	0,78	0,20	3,62	0,09	1761	14	39	144	16	484,1	54,4	89
C - PSEUDOSTEM	P-22-02553	0,64	0,09	0,68	0,07	4,07	0,07	129	3	15	109	14	494,9	40,5	92
C - LEAVES	P-22-02554	2,35	0,15	0,77	0,21	3,32	0,18	138	7	17	235	11	491,4	91,8	81

LAST. LINE

OBSERVATION:

***ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST**

Annex 125. Sixth análisis materia seca cultivo de abacá. PPhy-107-21

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R 01 (V3)

REPORT Nº 81951

USER: BIOTECH CR GRM S.A.
SUBCLIENT BIOTECH TEST #62-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL sredondo@laboratoriobiotech.com
TELEPHONE: 8701-2286

PROVINCE: LIMON
CANTO: GUACIMO

CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 08/06/2022
REPORT ISSUANCE: 17/06/2022
Nº OF TOTAL SAMPLES: 6
PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

ID USER	IDLAB	g		%
		P.Fresh	P.Dry	Hum
A - CORM	P-22-02558	493,5	63,5	87
A - PSEUDOSTEM	P-22-02559	492,8	37,4	92
A - LEAVES	P-22-02560	489,3	88,5	82
B - CORM	P-22-02561	494,6	55,4	89
B - PSEUDOSTEM	P-22-02562	483,9	35,9	93
B - LEAVES	P-22-02563	495,4	100,0	80

---------- LAST LINE ----------

Annex 136. Sixth foliar chemical analysis of abacá cultivation (Offspring). PPhy-107-21

CIA Centro de Investigaciones Agronómicas

REPORT Nº: USER: SUBCLIENT

81950
BIOTECH CR GRM S.A. BIOTECH TEST - N°63-22

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT RE-R01

(3)

RESPONSIBLE: EMAIL TELEPHONE:

STEFANY REDONDO ROMERO Phytolab @laboratoriobiotech.com, sredondo @laboratoriobiotech.com 2552-8645, 8701-2286

ANALYSIS: QC,B,S, PF,PS

PROVINCE: LIMÓN

RECEPTION DATE: 08/06/2022

CANTON: GUÁCIMO

REPORT ISSUANCE: 17/06/2022

CROP:

N° OF TOTAL SAMPLES: 3

ABACA

PAGE:

1/1

CHEMICAL FOLIAR

ID USUARIO	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A – SUCKER CORM	P-22-02555	1,13	0,15	0,43	0,18	4,11	0,10	1416	13	47	137	16	487,7	49,3	90
A – SUCKER PSEUDOSTEM	P-22-02556	1,08	0,19	0,58	0,11	6,40	0,09	132	6	20	170	12	489,5	29,3	94
A – SUCKER LEAVES	P-22-02557	2,69	0,23	0,71	0,23	4,47	0,24	340	11	21	263	11	490,5	69,4	86

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 147. Sixth dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**81948**
USER:	BIOTECH CR GRM S.A.
SUBCLIENT	BIOTECH TEST - N°64-22
RESPONSIBLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE:	2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	GUACIMO
CROP:	ABACA

ANALYSIS:	PF,PS
RECEPTION DATE:	08/06/2022
REPORT ISSUANCE:	17/06/2022
Nº OF TOTAL SAMPLES:	6
PAGE:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
B – SUCKER CORM	P-22-02540	492,4	41,1	92
B – SUCKER PSEUDOSTEM	P-22-02541	541,3	27,3	95
B – SUCKER LEAVES	P-22-02542	487,4	80,0	84
C – SUCKER CORM	P-22-02543	495,2	50,2	90
C – SUCKER PSEUDOSTEM	P-22-02544	492,5	28,7	94
C – SUCKER LEAVES	P-22-02545	495,5	88,1	82

LAST LINE

Annex 18. Seventh foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

ilac-MRA ECA. Laboratorio de Ensayo Alcance de Acreditación N° LE-033 Acreditado a partir de: 2006.06.12 Alcance disponible en www.eca.or.cr

REPORT Nº: 82374

USER: SUBCLIENT RESPONSIBLE: EMAIL TELEPHONE: BIOTECH CRGRMS. A. TICKET #70-22 STEFANY REDONDO ROMERO Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com 2552-8645, 8701-2286

ANALYSIS: QC,B,S, PF,PS

PROVINCE: LIMÓN

RECEPTION DATE: 15/07/2022

CANTON: GUÁCIMO

REPORT ISSUANCE: 22/07/2022

AREA CROP: RÍO JIMÉNEZ SAMPLES: 9 ABACA

Nº OF TEST

PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N^	P^	Ca^	Mg^	K^	S^	Fe^	Cu^	Zn^	Mn^	B^	P.Fresh^^	P.Dry^^	Hum^^
BIOTECH TEST - A CORM	P-22-03107	0,83	0,12	0,58	0,14	3,32	0,11	1165	15	48	148	14	488,5	67,8	86

BIOTECH TEST - A PSEUDOTALLO	P-22-03108	0,49	0,13	0,46	0,05	4,33	0,06	153	3	14	124	9	488,3	39,9	92
BIOTECH TEST - A HOJAS	P-22-03109	2,09	0,19	0,49	0,16	3,61	0,18	164	7	19	262	11	493,0	89,6	82
BIOTECH TEST - B CORMO	P-22-03110	0,73	0,10	0,53	0,16	3,18	0,11	1132	13	34	127	13	487,8	65,9	86
BIOTECH TEST - B PSEUDOTALLO	P-22-03111	0,54	0,11	0,51	0,06	4,29	0,07	224	4	14	110	11	489,3	40,5	92
BIOTECH TEST - B HOJAS	P-22-03112	1,80	0,19	0,45	0,16	3,17	0,17	97	7	19	169	11	487,6	97,1	80
BIOTECH TEST - C CORMO	P-22-03113	0,90	0,13	0,54	0,17	4,63	0,10	1514	13	33	147	14	488,7	49,6	90
BIOTECH TEST - C PSEUDOTALLO	P-22-03114	0,68	0,09	0,49	0,06	4,57	0,06	176	4	13	98	10	482,9	41,2	91
BIOTECH TEST - C HOJAS	P-22-03115	2,27	0,18	0,44	0,19	3,26	0,17	73	7	18	185	12	491,5	102,3	79

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 159. Seventh dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

82372

REPORT Nº: USER: BIOTECH CR GRM
SUBCLIENT S.A. BOLETA #71-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL TELEPHONE: sredondo@laboratoriobiotech.co m 8701-2286

ANALYSIS PF,PS

PROVINCE: LIMÓN RECEPTION DATE: 15/07/2022

CANTON: GUÁCIMO REPORT ISSUANCE: 22/07/2022

CULTIVO:

Nº OF TOTAL SAMPLES: 6

ABACA

PAGE: 1/1

FOLIAR CHEMICAL ANALYSIS

USER ID		IDLAB	g		%
			P.Fresh**	P.Dry**	Hum**
BIOTECH TEST-	A - CORM	P-22-03098	489,0	62,4	87
BIOTECH TEST-	A - PSEUDOSTEM	P-22-03099	486,5	38,7	92
BIOTECH TEST-	A - LEAVES	P-22-03100	488,3	87,5	82
BIOTECH TEST-	B - SUCKER CORM	P-22-03101	489,7	69,9	86
BIOTECH TEST-	B - PSEUDOSTEM	P-22-03102	488,4	38,8	92
BIOTECH TEST-	B - LEAVES	P-22-03103	487,3	93,9	81

---------- LAST LINE ----------

Annex 20. Seventh foliar chemical analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01(V3)

REPORT Nº: 82373

USER: BIOTECH CR GRM S.A.
SUBCLIENT: TICKET #72-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL: Phytolab@laboratoriobiotech.com sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645; 8701-2286

PROVINCE: LIMON
CANTON: GUACIMO
AREA: RIO JIMENEZ
CROP: ABACA

ANALYSIS: QC,B,S, PF,PS
RECEPTION DATE: 15/07/2022
REPORT ISSUANCE: 22/07/2022
Nº OF TOTAL SAMPLES: 3
PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST - A SUCKER CORM	P-22-03104	1,04	0,16	0,66	0,18	5,25	0,13	1984	15	51	198	22	485,0	44,2	91
BIOTECH TEST - A SUCKER PSEUDOSTEM	P-22-03105	0,75	0,24	0,59	0,10	6,07	0,08	669	6	26	139	15	486,8	34,0	93
BIOTECH TEST - A SUCKER LEAVES	P-22-03106	2,58	0,21	0,53	0,18	3,83	0,22	128	8	19	304	9	487,9	91,5	81

---------- LAST LINE ----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 21. Seventh dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**82371**
USER:	BIOTECH CR GRM
SUBCLIENT	S.A. BOLETA #73-22
RESPONSIBLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com,
TELEPHONE:	sredondo@laboratoriobiotech.com 2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	GUACIMO
CROP:	ABACA

ANALYSIS:	PF,PS
RECEPTION DATE:	15/07/2022
REPORT ISSUANCE:	22/07/2022
Nº OF TOTAL SAMPLES:	6
PAGE	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST- B - CORMO HIJO	P-22-03092	489,6	61,7	87
BIOTECH TEST - B - PSEUDOTALLO HIJO	P-22-03093	492,8	32,4	93
BIOTECH TEST - B – SUCKER LEAVES	P-22-03094	487,5	93,9	81
BIOTECH TEST - C -SUCKER CORM	P-22-03095	487,2	55,5	89
BIOTECH TEST - C – SUCKER PSEUDOTSTEM	P-22-03096	535,7	35,4	93
BIOTECH TEST - C – SUCKER LEAVES	P-22-03097	491,6	98,0	80

---------- LAST LINE ----------

Annex 22. Eight foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

82868

BIOTECH CR GRM S.A. TICKET #092-22

REPORT Nº: USER: SUBCLIENT

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R0

V
3

RESPONSIBLE: EMAIL TELEPHONE: STEFANY REDONDO ROMERO Phytolab @laboratoriobiotech.com, sredondo @laboratoriobiotech.com 2552-8645, 8701-2286

ANALYSIS: QC,B,S, PF,PS

PROVINCE: LIMÓN RECEPTION DATE: 25/08/2022

CANTON: GUÁCIMO REPORT ISSUANCE: 01/09/2022

AREA CROP: RÍO JIMÉNEZ
9
ABACA

Nº OF TOTAL SAMPLES:

PAGES:
1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A-CORM	P-22-03660	0,74	0,10	0,48	0,14	3,19	0,09	1205	15	31	118	15	513,3	70,6	86
A-PSEUDOSTEM	P-22-03661	0,49	0,10	0,53	0,07	4,29	0,06	298	4	17	124	12	506,2	39,9	92
A-LEAVES	P-22-03662	2,01	0,17	0,78	0,16	3,28	0,19	422	7	20	312	13	488,7	91,2	81
B-CORM	P-22-03663	0,74	0,10	0,58	0,16	3,39	0,09	820	12	35	113	14	562,9	66,3	88
B-PSEUDOSTEM	P-22-03664	0,48	0,11	0,51	0,07	4,04	0,06	305	6	17	90	12	486,8	43,0	91
B-LEAVES	P-22-03665	1,83	0,15	0,65	0,17	2,92	0,15	385	6	21	176	12	523,4	106,3	80
C-CORM	P-22-03666	0,74	0,08	0,49	0,15	2,50	0,08	890	13	34	105	13	502,2	75,0	85
C-PSEUDOSTEM	P-22-03667	0,73	0,12	0,71	0,09	4,59	0,07	812	6	21	141	16	543,7	38,5	93
C-LEAVES	P-22-03668	2,08	0,17	0,76	0,20	2,81	0,17	272	7	21	278	14	504,7	110,7	78

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 23. Eight dry matter analysis of abacá cultivation. PPhy-107-21

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**82873**
USER:	BIOTECH CR GRM S.A.
SUBCLIENT	TICKET #095-22
RESPONSIBLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE:	2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	GUACIMO
AREA	RIO JIMENEZ
CROP:	ABACA

ANALYSIS:	PF,PS
RECEPTION DATE:	25/08/2022
REPORT ISSUANCE:	01/09/2022
Nº OF TOTAL SAMPLES:	6
PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST - B-CORMO HIJO	P-22-03670	548,7	60,2	89
BIOTECH TEST - B-PSEUDOTALLO HIJO	P-22-03671	537,1	38,8	93
BIOTECH TEST - B-HOJAS HIJO	P-22-03672	501,3	102,6	80
BIOTECH TEST - C-CORMO HIJO	P-22-03673	505,4	56,5	89
BIOTECH TEST - C-PSEUDOTALLO HIJO	P-22-03674	302,9	36,0	88
BIOTECH TEST - C-HOJAS HIJO	P-22-03675	509,3	101,5	80

LAST LINE

Annex 24. Eight foliar chemical analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

CIA Centro de Investigaciones Agronómicas

ilac-MRA ECA. ENTE COSTARRICENSE DE ACREDITACIÓN
Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**82874**		
USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	TICKET #094-22		
RESPONSIBLE:	BIOTECH CR GRM S.A.		
EMAIL	Phytolab@laboratoriobiotech.com		
TELEPHONE:	2552-8645		
		ANALYSIS:	QC,B,S, PF,PS
PROVINCE:	LIMON	RECEPTION DATE:	25/08/2022
CANTON:	GUACIMO	REPORT ISSUANCE:	01/09/2022
AREA	RIO JIMENEZ	Nº DE MUESTRAS TOTAL:	3
CROP:	ABACA	PAGINA:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A – SUCKER CORM	P-22-03676	1,00	0,12	0,53	0,17	4,29	0,10	1811	17	43	160	17	538,4	57,3	89
A – SUCKER PSEUDOSTEM	P-22-03677	0,71	0,15	0,64	0,08	6,15	0,07	592	6	22	163	16	516,5	35,2	93
A – SUCKER LEAVES	P-22-03678	2,44	0,23	0,68	0,22	3,58	0,22	948	11	24	386	15	490,7	89,0	82

---------- LAST LINE ----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 25. Eight dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR ANALYSIS

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**82873**
USER:	BIOTECH CR GRM S.A.
SUBCLIENT	BOLETA #095-22
RESPONSIBLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE:	2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	GUACIMO
AREA	RIO JIMENEZ
CROP:	ABACA

ANALYSIS:	PF,PS
REPORT DATE:	25/08/2022
REPORT ISSUANCE:	01/09/2022
Nº OF TOTAL SAMPLES:	6
PAGE:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST - B-SUCKER CORM	P-22-03670	548,7	60,2	89
BIOTECH TEST - B-SUCKER PSEUDOSTEM	P-22-03671	537,1	38,8	93
BIOTECH TEST - B-SUCKER LEAVES	P-22-03672	501,3	102,6	80
BIOTECH TEST - C-SUCKER CORM	P-22-03673	505,4	56,5	89
BIOTECH TEST - C-SUCKER PSEUDOSTEM	P-22-03674	302,9	36,0	88
BIOTECH TEST - C-SUCKER LEAVES	P-22-03675	509,3	101,5	80

LAST LINE

Annex 26. Ninth foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORA

TEST REPORT

RE-R01 (V3)

ilac-MRA ECA. ENTE COSTARRICENSE DE ACREDITACIÓN
Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

REPORT Nº:	**83429**		
USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	TICKET #120-22		
RESPONSIBLE:	STEFANY REDONDO ROMERO		
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com		
TELEPHONE:	2552-8645, 8701-2286		
PROVINCE:	LIMON	ANALYSIS:	QC,B,S, PF,PS
CANTON:	GUACIMO	RECEPTION DATE:	06/10/2022
AREA	RIO JIMENEZ	REPORT ISSUANCE:	14/10/2022
CROP:	ABACA	Nº OF TOTAL SAMPLES:	9
		PAGE:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A-CORM	P-22-04202	0,67	0,11	0,57	0,17	2,82	0,11	1015	12	45	129	15	523,8	66,5	87
A-PSEUDOSTEM	P-22-04203	0,48	0,16	0,51	0,10	3,71	0,06	462	5	17	117	12	495,4	39,1	92
A-LEAVES	P-22-04204	1,74	0,23	0,63	0,27	2,67	0,22	261	6	19	240	11	491,5	112,2	77
B-CORM	P-22-04205	0,78	0,11	0,48	0,19	3,02	0,10	1928	11	36	123	16	502,5	67,2	87
B-PSEUDOSTEM	P-22-04206	0,54	0,11	0,64	0,10	4,14	0,07	431	4	26	113	15	493,4	5,0	99
B-LEAVES	P-22-04207	1,88	0,18	0,78	0,21	2,77	0,19	246	6	20	293	13	490,7	111,4	77
C-CORM	P-22-04208	0,61	0,08	0,59	0,15	3,11	0,08	370	9	29	75	11	513,5	63,7	88
C-PSEUDOSTEM	P-22-04209	0,45	0,12	0,57	0,07	4,27	0,05	208	3	15	83	11	490,1	38,7	92
C-LEAVES	P-22-04210	2,33	0,23	0,74	0,28	3,34	0,22	260	8	21	256	13	492,2	97,8	80

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 27. Ninth dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**83430**		
USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	TICKET #121-22		
RESPONSIBLE:	STEFANY REDONDO ROMERO		
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com		
TELEPHONE:	2552-8645, 8701-2286		
		ANALYSIS:	PF,PS
PROVINCE:	LIMON	RECEPTION DATE:	06/10/2022
CANTON:	POCOCI	REPORT ISSUANCE:	14/10/2022
LOCALIDAD	JIMENEZ	Nº OF TOTAL SAMPLES:	6
CROP:	ABACA	PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
A-CORM	P-22-04211	509,9	67,9	87
A-PSEUDOSTEM	P-22-04212	489,2	40,4	92
A-LEAVES	P-22-04213	495,5	123,2	75
B-CORM	P-22-04214	520,8	76,2	85
B-PSEUDOSTEM	P-22-04215	491,7	41,0	92
B-LEAVES	P-22-04216	493,6	115,6	77

LAST LINE

Annex 28. Ninth foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

TEST REPORT

RE-R01 (V3)

REPORT Nº:	**83431**
USER:	BIOTECH CR GRM S.A.
SUBCLIENT	TICKET N#122-22
RESPONSIBLE:	STEFANY REDONDO ROMERO
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE:	2552-8645, 8701-2286
PROVINCE:	LIMON
CANTON:	POCOCI
AREA	JIMENEZ
CUROP:	ABACA
ANALYSIS:	QC,B,S, PF,PS
RECEPTION DATE:	06/10/2022
REPORT ISSUANCE:	14/10/2022
Nº OF TOTAL SAMPLES	3
PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry	Hum**
A-SUCKER CORM	P-22-04217	0,58	0,11	0,35	0,18	2,94	0,08	584	8	21	84	11	527,5	64,9	88
A-SUCKER PSEUDOSTEM	P-22-04218	0,45	0,25	0,44	0,12	4,76	0,07	331	4	16	91	13	490,1	33,1	93
A-SUCKER LEAVES	P-22-04219	1,97	0,25	0,77	0,28	3,47	0,24	308	8	24	300	13	499,3	93,8	81

----------LAST. LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 29. Ninth dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

Nº DE REPORTE: **83432**

USER: BIOTECH CR GRM S.A.
SUBCLIENT TICKET #123-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMON
CANTON: POCOCI
AREA JIMENEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 06/10/2022
REPORT ISSUANCE: 14/10/2022
Nº OF TOTAL SAMPLES: 6
PAGES: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
B-SUCKER CORM	P-22-04220	496,9	75,4	85
B-SUCKER PSEUDOSTEM	P-22-04221	492,4	35,0	93
B-SUCKER LEAVES	P-22-04222	494,4	106,7	78
C-SUCKER CORM	P-22-04223	511,5	73,0	86
C-SUCKER PSEUDOSTEM	P-22-04224	490,9	34,5	93
C-SUCKER LEAVES	P-22-04225	490,3	125,0	75

LAST LINE

Annex 30. Tenth foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

SOIL AND FOLIAR ANALYSIS

TEST REPORT

RE-R01 (V3)

REPORT Nº: **84186**

USER: BIOTECH CR GRM S.A.
SUBCLIENT: No.143-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMON
CANTON: GUACIMO
AREA: RIO JIMENEZ
CROP: ABACA

ANALYSIS: QC,B,S, PF,PS
RECEPTION DATE: 24/11/2022
REPORT ISSUANCE: 02/12/2022
Nº OF TEST SAMPLES: 9
PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST A - CORM - GROUP 1	P-22-05148	0,59	0,09	0,48	0,17	2,17	0,10	1167	12	37	98	12	497,9	81,4	84
BIOTECH TEST A - PSEUDOSTEM - GROUP 1	P-22-05149	0,54	0,15	0,61	0,09	3,33	0,07	461	3	24	97	13	492,9	40,7	92
BIOTECH TEST A - LEAVES - GROUP1	P-22-05150	1,66	0,21	0,74	0,23	2,58	0,19	115	5	18	197	12	490,8	110,8	77
BIOTECH TEST B - CORM - GROUP1	P-22-05151	0,68	0,11	0,59	0,21	3,00	0,11	831	10	38	118	12	495,5	64,7	87
BIOTECH TEST B - PSEUDOTALLO - GRUPO 1	P-22-05152	0,56	0,20	0,49	0,10	3,61	0,06	400	3	25	94	11	500,5	40,3	92
BIOTECH TEST B - LEAVES- GROUP 1	P-22-05153	1,70	0,22	1,08	0,27	2,58	0,22	361	5	21	368	12	491,1	102,2	79
BIOTECH TEST C - CORM - GROUP 1	P-22-05154	0,65	0,12	0,53	0,16	3,36	0,08	2182	14	47	107	15	493,9	68,1	86
BIOTECH TEST C - PSEUDOSTEM- GROUP 1	P-22-05155	0,60	0,22	0,60	0,12	6,31	0,08	1139	6	56	100	16	492,0	34,2	93
BIOTECH TEST C - LEAVES - GROUP 1	P-22-05156	2,23	0,22	0,50	0,24	3,04	0,19	363	7	20	144	11	495,6	106,4	79

LAST LINE

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 31. Tenth dry matter analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº: **84188**

USER: BIOTECH CR GRM S.A.
SUBCLIENT: No.144-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL: Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMON
CANTON: GUACIMO
AREA: RIO JIMENEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 24/11/2022
REPORT ISSUANCE: 02/12/2022
Nº OF TEST SAMPLES: 6
PAGE: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST A - CORM - GROUP 2	P-22-05157	504,2	82,2	84
BIOTECH TEST A - PSEUDOSTEM - GROUP 2	P-22-05158	497,2	44,1	91
BIOTECH TEST A - LEAVES - GROUP 2	P-22-05159	497,2	114,7	77
BIOTECH TEST B - CORM - GROUP 2	P-22-05160	499,0	77,2	85
BIOTECH TEST B - PSEUDOSTEM - GROUP 2	P-22-05161	500,5	40,3	92
BIOTECH TEST B - LEAVES - GROUP 2	P-22-05162	495,4	103,0	79

LAST LINE

Annex 32. Tenth foliar chemical analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIUDAD DE LA INVESTIGACIÓN

SOIL AND FOLIAR LABORATORY

CIA Centro de Investigaciones Agronómicas

Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
De manera indefinida Art. 11, Decreto ejecutivo 35522 y sus modificaciones
Alcance disponible en www.eca.or.cr

TEST REPORT
RE-R01 (V3)

REPORT Nº: **84189**

USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	No.145-22		
RESPONSIBLE:	STEFANY REDONDO ROMERO		
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com		
TELEPHONE:	2552-8645, 8701-2286		
		ANALYSIS:	QC,B,S, PF,PS
PROVINCE:	LIMON	RECEPTION DATE:	24/11/2022
CANTON:	GUACIMO	REPORT ISSUANCE:	02/12/2022
AREA	RIO JIMENEZ	Nº OF TEST SAMPLES:	3
CROP:	ABACA	PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
BIOTECH TEST A – SUCKER CORM	P-22-05163	0,69	0,11	0,49	0,22	2,72	0,11	1495	12	36	121	13	500,1	67,7	86
BIOTECH TEST A – SUCKER PSEUDOSTEM	P-22-05164	0,65	0,30	0,55	0,13	4,89	0,08	1170	7	24	109	14	496,8	32,8	93
BIOTECH TEST A – SUCKER LEAVES	P-22-05165	2,00	0,24	0,55	0,27	2,96	0,22	179	7	19	181	10	498,9	103,6	79

---------- LAST LINE ----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

Annex 33. Tenth dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº: **84190**

USER: BIOTECH CR GRM S.A.
SUBCLIENT No.146-22
RESPONSIBLE: STEFANY REDONDO ROMERO
EMAIL Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMON
CANTON: GUACIMO
REA RIO JIMENEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 24/11/2022
REPORT ISSUANCE: 02/12/2022
Nº OF TOTAL SAMPLES: 6
PAGES: 1/1

CHEMICAL FOLIAR ANALYSIS

ID USUARIO	IDLAB	g		%
		P.Fresh	P.Dry	Hum
BIOTECH TEST B - CORMO HIJO	P-22-05166	500,2	63,5	87
BIOTECH TEST B - PSEUDOTALLO HIJO	P-22-05167	498,6	32,2	94
BIOTECH TEST B – SUCKER LEAVES	P-22-05168	498,4	96,5	81
BIOTECH TEST C – SUCKER CORM	P-22-05169	498,1	66,9	87
BIOTECH TEST C – SUCKER PSEUDOSTEM	P-22-05170	489,6	30,3	94
BIOTECH TEST C – SUCKER LEAVES	P-22-05171	502,6	100,7	80

LAST LINE

Annex 34. Eleventh foliar chemical analysis of abacá cultivation. PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

ECA. Laboratorio de Ensayo Alcance de Acreditación Nº LE-033 Acreditado a partir de: 2006.06.12 Alcance disponible en www.eca.or.cr

CIUDAD DE LA INVESTIGACIÓN
LABORATORIO DE SUELOS Y FOLIARES

REPORTE DE ENSAYO

RE-R01 (V3)

Nº DE REPORTE: 85550

USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	BOLETA #19-23		
RESPONSIBLE:	STEFANY REDONDO ROMERO		
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com		
TELEPHONE:	2552-8645, 8701-2286		
		ANALYSIS:	QC,B,S, PF,PS
PROVINCE:	LIMON	RECEPTION DATE:	23/03/2023
CANTON:	GUACIMO	REPORT ISSUANCE:	30/03/2023
AREA	RIO JIMENEZ	Nº OF TEST SAMPLES:	9
CROP:	ABACA	PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass						mg/kg					g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Cu*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A-CORM	P-23-01726	0,56	0,09	0,40	0,14	1,77	0,08	551	8	22	68	10	501,7	91,4	82
A-PSEUDOTSTEM	P-23-01727	0,43	0,16	0,50	0,09	2,03	0,06	316	2	21	102	10	489,4	40,9	92
A-LEAVES	P-23-01728	1,12	0,26	0,73	0,20	2,61	0,17	265	5	17	196	12	492,3	93,7	81
B-CORM	P-23-01729	0,61	0,07	0,48	0,16	1,51	0,09	858	7	31	95	10	492,6	72,0	85
B-PSEUDOSTEM	P-23-01730	0,43	0,12	0,52	0,07	1,66	0,05	336	2	15	86	9	513,3	53,4	90
B-LEAVES	P-23-01731	1,23	0,22	0,59	0,16	2,13	0,13	420	5	16	140	11	489,9	96,3	80
C-CORM	P-23-01732	0,50	0,09	0,48	0,15	2,09	0,09	740	8	37	90	11	494,0	79,0	84
C-PSEUDOSTEM	P-23-01733	0,50	0,21	0,47	0,09	2,70	0,07	472	3	22	78	10	508,7	50,4	90
C-LEAVES	P-23-01734	1,56	0,22	0,59	0,23	2,62	0,15	211	5	19	169	11	516,9	105,6	80

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED TEST

B.Q. Marianela Blanco M.
N.I. 2468
Quality Management

Ing. Agr. Ma. Fernanda Campos G.
N.I. 9447
Technical Management

1. Las unidades están expresadas en base seca, en masa/masa. 2. Procedimiento: N por combustión seca en Autoanalizador de acuerdo al M-N; P, Ca, Mg, K, S, Na, Fe, Cu, Zn, Mn, B y Al por digestión húmeda con HNO_3 y determinación por Espectrometría de Emisión Atómica con Plasma (ICP) de acuerdo al M-ICP. 3. El muestreo es responsabilidad del usuario. 4. Los resultados se ref ieren únicamente a las muestras ensay adas. 5. El tiempo de custodia de las muestras es de 45 días a partir del ingreso de la muestra. 6. El Reporte de Ensay o con v alidez legal es el original f irmado; cuando el usuario solicita el env ío del reporte por correo electrónico libera al Laboratorio de resguardar la integridad y conf idencialidad de sus resultados.

Annex 35. Eleventh análisis materia seca cultivo de abacá. PPhy-107-21

CIUDAD DE LA INVESTIGACIÓN

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº : 85551

USER: BIOTECH CR GRM S.A.
SUBCLIENT TICKET #20-23 RESPONSIBLE:
STEFANY REDONDO ROMERO
EMAIL Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMÓN
CANTON: GUÁCIMO
AREA RÍO JIMÉNEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 23/03/2023
REPORT ISSUANCE: 30/03/2023
Nº OF TEST SAMPLE: 6
PAGES: 1/1

ANÁLISIS QUÍMICO FOLIAR

USER ID	IDLAB	g P.Fresh	g P.Dry	% Hum
A-CORM	P-23-01735	488,2	86,0	82
A-PSEUDOSTEM	P-23-01736	491,9	46,1	91
A-LEAVES	P-23-01737	503,5	117,6	77
B-CORM	P-23-01738	494,4	81,2	84
B-PSEUDOSTEM	P-23-01739	495,8	50,0	90
B-LEAVES	P-23-01740	493,9	108,1	78

----------LAST LINE----------

488,2 86,0 82
494,4 81,2 84
491,9 46,1 91
495,8 50,0 90
503,5 117,6 77
493,9 108,1 78

B.Q. Marianela Blanco M.
N.I. 2468
Gestoría de Calidad

Ing. Agr. Ma. Fernanda Campos G.
N.I. 9447
Gestoría Técnica

1. The units are expressed on a dry basis, in mass/mass. 2. Procedure: N by dry combustion in an Autoanalyzer according to M-N; P, Ca, Mg, K, S, Na, Fe, Cu, Zn, Mn, B, and Al by wet digestion with HNO3 and determination by Atomic Emission Spectrometry with Plasma (ICP) according to M-ICP. 3. Sampling is the responsibility of the user. 4. The results refer only to the samples tested. 5. The sample custody time is 45 days from the date of sample entry. 6. The legally valid Test Report is the original signed copy; when the user requests the report to be sent by email, it releases the Laboratory from safeguarding the integrity and confidentiality of the results.

Annex 36. Eleventh foliar chemical analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

Laboratorio de Ensayo
Alcance de Acreditación Nº LE-033
Acreditado a partir de: 2006.06.12
Alcance disponible en www.eca.or.cr

REPORT Nº:	**85552**		
USER:	BIOTECH CR GRM S.A.		
SUBCLIENT	TICKET #21-23		
RESPONSIBLE:	STEFANY REDONDO ROMERO		
EMAIL	Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com		
TELEPHONE:	2552-8645, 8701-2286		
PROVINCE:	LIMON	ANALYSIS:	QC,B,S, PF,PS
CANTON:	GUACIMO	RECEPTION DATE:	23/03/2023
AREA	RIO JIMENEZ	REPORT ISSUANCE:	30/03/2023
CROP:	ACABA	Nº OF TOTAL SAMPLES:	3
		PAGES:	1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	% mass					mg/kg				g		%
		N*	P*	Ca*	Mg*	K*	S*	Fe*	Zn*	Mn*	B*	P.Fresh**	P.Dry**	Hum**
A – SUCKER CORM														
HIJO	P-23-01741	0,56	0,11	0,27	0,20	1,73	0,06	3361	15	25	122	13	494,4	87,2	82
A – SUCKER PSEUDOSTEM	P-23-01742	0,50	0,18	0,58	0,10	2,90	0,06	654	4	14	105	11	535,1	44,2	92
A – SUCKER LEAVES	P-23-01743	1,34	0,21	0,65	0,27	2,66	0,18	138	4	16	148	10	508,2	100,9	80

----------LAST LINE----------

OBSERVATION: *ACCREDITED TEST, see scope at www.eca.or.cr **NON-ACCREDITED

B.Q. Marianela Blanco M. **Ing. Agr. Ma. Fernanda Campos G.**
N.I. 2468 **N.I. 9447**
Quality Management **Technical Management**

1. The units are expressed on a dry basis, mass/mass. 2. Procedure: Nitrogen by dry combustion in Autoanalyzer according to M-N method; Phosphorus, Calcium, Magnesium, Potassium, Sulfur, Sodium, Iron, Copper, Zinc, Manganese, Boron, and Aluminum by wet digestion with HNO3 and determined by Plasma Atomic Emission Spectrometry (ICP) according to the M-ICP method. 3. Sampling is the responsibility of the user. 4. The results refer only to the tested samples. 5. The storage time of the samples is 45 days from the entry of the sample. 6. The legally valid Test Report is the original signed document; when the user requests the report to be sent by email, they release the Laboratory from safeguarding the integrity and confidentiality of the results.

Annex 37. Eleventh dry matter analysis of abacá cultivation (Offspring). PPhy-107-21

UNIVERSIDAD DE COSTA RICA

CIA Centro de Investigaciones Agronómicas

CIUDAD DE LA INVESTIGACIÓN
SOIL AND FOLIAR LABORATORY

TEST REPORT

RE-R01 (V3)

REPORT Nº: 85553

USER: BIOTECH CR GRM S.A.
SUBCLIENT BOLETA #22-23 RESPONSIBLE:
STEFANY REDONDO ROMERO
EMAIL Phytolab@laboratoriobiotech.com, sredondo@laboratoriobiotech.com
TELEPHONE: 2552-8645, 8701-2286

PROVINCE: LIMÓN
CANTON: GUÁCIMO
AREA RÍO JIMÉNEZ
CROP: ABACA

ANALYSIS: PF,PS
RECEPTION DATE: 23/03/2023
REPORT ISSUANCE: 30/03/2023
Nº OF TOTAL SAMPLES: 6
PAGES: 1/1

CHEMICAL FOLIAR ANALYSIS

USER ID	IDLAB	g		%
		P.Fresh	P.Dry	Hum
B-SUCKER CORM	P-23-01744	525,4	82,0	84
B-SUCKER PSEUDOSTEM	P-23-01745	504,3	47,1	91
B-SUCKER LEAVES	P-23-01746	488,0	96,0	80
C-SUCKER CORM	P-23-01747	500,8	76,9	85
C-SUCKER PSEUDOSTEM	P-23-01748	500,8	39,1	92
C-SUCKER LEAVES	P-23-01749	497,9	91,9	82

----------LAST LINE----------

B.Q. Marianela Blanco M.
N.I. 2468
Quality Management

Ing. Agr. Ma. Fernanda Campos G.
N.I. 9447
Technical Management

1. The units are expressed on a dry basis, in mass/mass. 2. Procedure: N by dry combustion in Autoanalyzer according to M-N; P, Ca, Mg, K, S, Na, Fe, Cu, Zn, Mn, B, and Al by wet digestion with HNO3 and determination by Atomic Emission Spectrometry with Plasma (ICP) according to M-ICP. 3. Sampling is the user's responsibility. 4. The results refer only to the samples tested. 5. The custody time of the samples is 45 days from the entry of the sample. 6. The Test Report with legal validity is the original signed; when the user requests the report to be sent by email, they release the Laboratory from safeguarding the integrity and confidentiality of the results.

Annex 38. Logbook of activities carried out during the trial development

ABACA	Activity	Date	Days	Week Year
	Date of planting	10/11/2021	0	46
	1er Nutritional sample	10/12/2021	30	50
	2do Nutritional sample	9/1/2022	60	3
	3er Nutritional sample	8/2/2022	90	7
	4to Nutritional sample	10/3/2022	120	11
	5to Nutritional sample	9/4/2022	150	15
	6to Nutritional sample	7/6/2022	195	24
	7mo Nutritional sample	8/7/2022	240	28
	8vo Nutritional sample	22/8/2022	285	35
	9no Nutritional sample	6/10/2022	330	41
	10mo Nutritional sample	20/11/2022	375	48
	11mo Nutritional sample	20/3/2023	495	12