



**Diversifying cropping systems - Traditional knowledge and innovative approaches. Divecrops  
Workshop 2019**

**Activities carried out and perspectives in Granma, Cuba.**

*Prof.Dr. Raúl Carlos López Sánchez and Prof.Dr. Quirino Arias Cedeño. Granma University*

**Efect of sugar cane ash in horticultural crops under organoponics conditions.**

## Effect of sugar cane ash in horticultural crops under organoponics conditions.

### Effect of application of sugar cane ash in lettuce and cucumber

#### Treatments:

T-1 : 8.5 tn.ha<sup>-1</sup> ash

T-2 : Control



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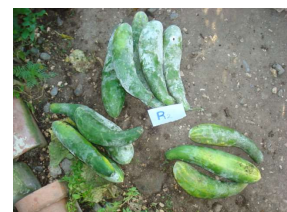
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### Experiment in field conditions

#### Effect of application of sugar cane ash in lettuce and cucumber

##### Cucumber

Parameters	Total	
	Control	Ash fertilizer
Length of fruits (cm)	20.33 b	29.21 a
Diameter of fruits (cm)	5.62 b	7.87 a
Yield (kg.m <sup>2</sup> )	2.1 b	3.14 a



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## Experiment in field conditions

### Effect of application of sugar cane ash in lettuce and cucumber

#### Lettuce

Parameters	Control	Ash fertilizer
Root fresh matter (g.plant <sup>-1</sup> )	0.38 b	0.87 a
Fresh matter (g.plant <sup>-1</sup> )	8.13 b	9.87 a
Dry matter (g.plant <sup>-1</sup> )	0.55 b	0.82a
Root dry matter (g.plant <sup>-1</sup> )	0.009 b	0.02 a
Leave number	6	6
Root length (cm)	5.0 b	5.95 a
Shoot height (cm)	6.0 b	9.3 a
Leaf area (cm <sup>2</sup> )	616.96 b	706.14 a



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#### Next activities:

#### Evaluations to be carried out in Germany

##### Soil:

Pw water soluble P, Pdl double lactate soluble P, Pox oxalate soluble P, DPS degree of P saturation, PSC P sorption capacity, Pt total

##### Plant:

Macro and micronutrients concentrations.

#### Evaluations to be carried out in Cuba

- Fertilization effects of sugar cane ash and humus combination in Cuban vegetable crops
- Residual ash effect in follow crops

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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba



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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

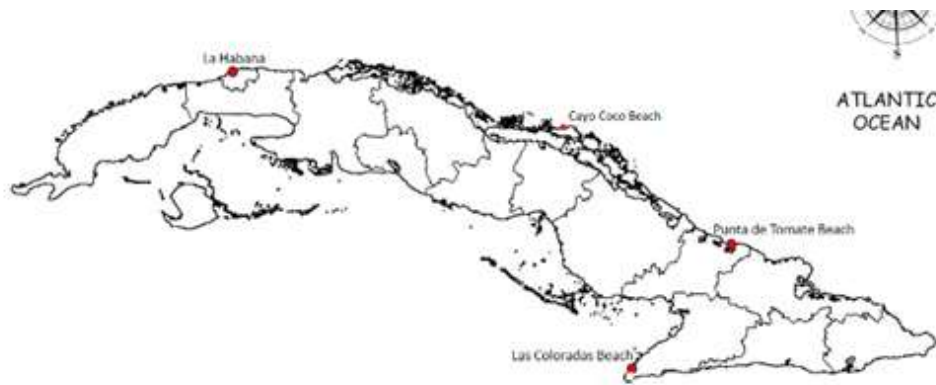
Seagrape, a small tree planted along sandy beaches as an ornamental or windbreak, is easily identified by the rounded or kidney-shaped thick and leathery leaves, which are slightly broader than long, often reddish when young or very old, and by the drooping grapelike clusters of crowded purple edible fruits about 3.4 inch (2 cm) long.



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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba



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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

Geographic location, annual precipitation, mean annual temperature in the studied provenances

Provenances	Latitude (N)	Longitude (W)	Precipitation (mm)	Mean annual Temperatura (C°)	pH
Playa Las Coloradas, Granma province	19° 56' 00" N	77° 41' 00"	942	27	8,91
Playa Punta de Tomate, Tunas province	21°07'30"N	75°49'44"	974	26.4	8,84
Cayo Coco, Ciego de Avila province	22° 32' 10.06"	78° 21' 19.44"	855	25.6	8,75

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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

Characteristics of seagrape fruits from different provenances in Cuba

Provenances	Fruit weight (g)	Fruit diameter (cm)	Fruit length (cm)	Seed diameter (cm)	Seed weight (g)	Seed length (cm)	Pulp weight (g)
Playa Las Coloradas, Granma province	2.3 c	11.8 c	16.3 c	10.5 a	0.49 b	15.9 b	1.8 b
Playa Punta de Tomate, Tunas province	3.38 a	17.3 a	19.3 a	9.7 b	0.45 b	17 b	2.9 a
Cayo Coco, Ciego de Avila province	2.47 b	15.4 b	17.3 b	10.45 a	0.52 a	15.6 a	1.94 b

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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

Morphological characteristic of *C. uvifera* seedlings from three provenances of Cuba.

Provenances	Shoot height (cm)	Root length (cm)	Dry matter (g)	Root dry matter (g)
Playa Las Coloradas, Granma province	15.62 a	10.2 a	0.52 a	0.12 a
Playa Punta de Tomate, Tunas province	14.92 b	9.8 b	0.51 b	0.08 b
Cayo Coco, Ciego de Avila province	13.38 c	8.86 c	0.49 b	0.07 b

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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

Ecophysiological characteristic of *C. uvifera* seedlings from three provenances of Cuba.

Provenances	Leaf wáter content (%)	Root wáter content (%)	Fv/Fm	Specific leaf área (cm <sup>2</sup> .g <sup>-1</sup> )
Playa Las Coloradas, Granma province	81.12 a	79.22 a	0.84 a	253.22 a
Playa Punta de Tomate, Tunas province	79.32 b	75.62 b	0.79 b	252.27 a
Cayo Coco, Ciego de Avila province	77.72 c	72.72 c	0.74 b	249.28 b

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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba



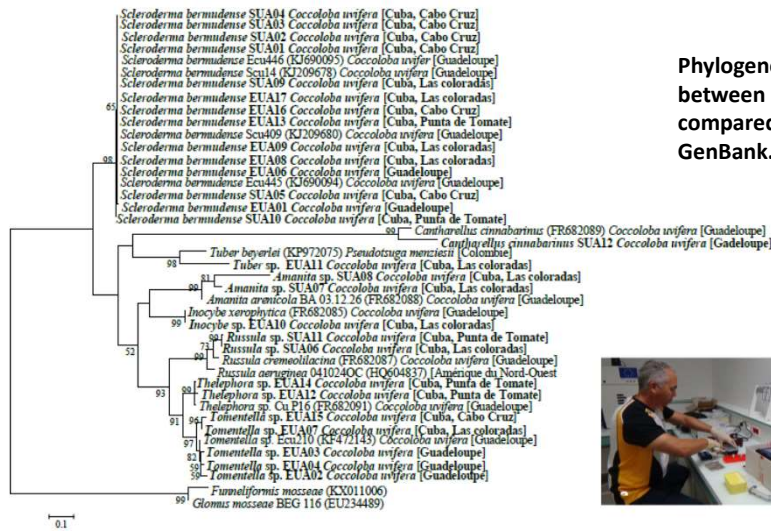
Recolection of ECM in three provenances of Cuba

(a) *Inocybe* sp. EUA10, (b) *Amanita* sp. SUA08, (c) *Russula* sp. SUA06, (d) *S. bermudense* SUA09, (e) ectomycorhizes jaunes EUA11 de *Tuber* sp., (f) ectomycorhizes blanc brillant EUA17 de *S. bermudense*.

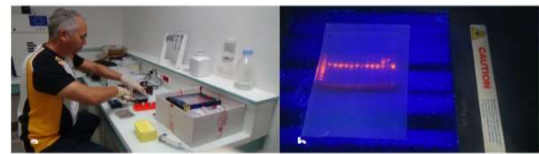
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## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba



Phylogenetic tree showing the relations between the ITS sequences of EMC of Cuba compared to sequences of reference in GenBank.



## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

Phylogenetic tree showing the relations between the ITS sequences of EMC of Cuba compared to sequences of reference in GenBank.

Numéro Herbier	Espèce fongique	Origine	Plante hôte	Forme biologique d'isolement	Taille ITS (pb)	Séquence de référence dans NCBI et origine	% de similarité
SUA07	Amanita sp.	Cuba (Las Coloradas)	C. uvifera	Sporophore	475	Amanita arenicola BA 03.12.26 (Guadeloupe)	92
SUA08	Amanita sp.	Cuba (Las Coloradas)	C. uvifera	Sporophore	396	Amanita arenicola BA 03.12.26 (Guadeloupe)	82
SUA12	Cantharellus cinnabarinus	Guadeloupe (Bois Jolan)	C. uvifera	Sporophore	549	Cantharellus cinnabarinus (Guadeloupe)	82
EUA10	Inocybe sp.	Cuba (Las Coloradas)	C. uvifera	Ectomycorhize	647	Inocybe xerophytica (Guadeloupe)	99
SUA06	Russula sp.	Cuba (Las Coloradas)	C. uvifera	Sporophore	682	Russula aeruginea (Amérique du Nord-Ouest)	90
SUA11	Russula sp.	Cuba (Punta de Tomate)	C. uvifera	Sporophore	681	Russula aeruginea (Amérique du Nord-Ouest)	89
EUA08	Scleroderma bermudense	Cuba (Las coloradas)	C. uvifera	Ectomycorhize	610	Scleroderma bermudense Ecu446 (Guadeloupe)	100
EUA09	Scleroderma bermudense	Cuba (Las Coloradas)	C. uvifera	Ectomycorhize	685	Scleroderma bermudense Scu409 (Guadeloupe)	100
EUA13	Scleroderma bermudense	Cuba (Punta de Tomate)	C. uvifera	Ectomycorhize	592	Scleroderma bermudense Scu14 (Guadeloupe)	100
EUA16	Scleroderma bermudense	Cuba (Cabo Cruz)	C. uvifera	Ectomycorhize	606	Scleroderma bermudense Ecu446 (Guadeloupe)	99
EUA17	Scleroderma bermudense	Cuba (Las Coloradas)	C. uvifera	Ectomycorhize	604	Scleroderma bermudense Ecu446 (Guadeloupe)	99
SUA01	Scleroderma bermudense	Cuba (Cabo Cruz)	C. uvifera	Sporophore	603	Scleroderma bermudense Ecu445 (Guadeloupe)	99
SUA02	Scleroderma bermudense	Cuba (Cabo Cruz)	C. uvifera	Sporophore	603	Scleroderma bermudense Ecu445 (Guadeloupe)	99
SUA03	Scleroderma bermudense	Cuba (Cabo Cruz)	C. uvifera	Sporophore	606	Scleroderma bermudense Ecu446 (Guadeloupe)	99



## Diversity of ectomycorrhizas and seagrape for salt tolerance in coastal ecosystems in Cuba

### Development of training on biodiversity of ECM and seagrape in coastal ecosystems in Cuba

The training was carried out with 7 young researchers from the Agricultural Faculty of Granma University and the Agricultural Research Institute "Jorge Dimitrov" and 20 students of Forestry Engineering ( 8th semester).



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## Effect of the application of ectomycorrhizas on seagrape seedlings

### Next activities:

### Evaluations to be carried out in Cuba

Capacity of the ectomycorrhizal (ECM) fungus, *Scleroderma bermudense*, to alleviate saline stress in seagrape (*Coccoloba uvifera* L.) seedlings with seeds of two provenances.



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## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Evaluation of 25 genotypes of bean (*Phaseolus vulgaris* L.) in fragile ecosystem in Granma province.

**Location:** Cooperativa de Créditos y Servicios (CSS) VIII Congreso 20°16'36"N 76°56'49"O (Municipio Yara, provincia Granma)

**Farmer:** Luis López Chávez



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## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Genotypes	Grain color	Progenitors	Institutions
CC 25-9	Negro	Selección de Ticos de Costa Rica.	INIFAT
BAT 304	Negro	Porrillo Sintético x Compuesto Chimalltenango	IIG
Tazumal	Negro	(Sal 22 G 4 x H 183 N) x (Ica Pijao x Turrialba 1)	IIG
Tomeguín 93	Negro	(DOR 364 x G 18521) x (DOR 365 x LM 30630)	IIG
CUL 156	Negro	DOR 364 x BAT 477	IIG
Liliana	Negro	UI 906 x Black Hawk) F1 x((Porrillo Sintético x G 2883) F1 x (FEB 188 x G 17341)F1)F1 /(NN)-C	IIG
Triunfo 70	Negro	---	INIFAT
Milagro villaclareño	Negro	---	INIFAT
Cubana 23	Negro	---	IIG
CUFIG 48	Negro	(DOR 364 x MAR 2) F 1 x ((G 2338 x A 483) F 1 (K 2 x G 17341) F 1) F 1/(NN) C	IIG
Velasco Largo	Rojo	---	INIFAT
CC 25-9 R	Rojo	Selección del CC 25-9	INIFAT
Guama 23	Rojo M	(Diacol Nima x Red Kote) x Red Kote	IIG
Delicias 364	Rojo	BAT 1215 x (RAB 116 x DOR 125)	IIG
Rubi	Rojo	---	INIFAT
Buenaventura	Rojo	(DOR 482 x G 1956)F1 x ((A 429 x XAN 309)F 1 x (A 193 x XAN 112) F1)F1/(NN)Q -(NN)C	IIG
CUFIG 110	Rojo	(Catrachita x XAN 309) F 1 x ((A 429 x G 16341) F 1 x (J 117 x G 17341) F 1) F 1/(NN) Q-(NN)	IIG
Engañador	Crema	(Veranic 2 x G1320) x (Jamapa x Tara)	IIG
Wacuto	Crema	----	INIFAT
La Cuba 154	Crema	Delicias 364 x BAT 477	IIG
Chévere	Blanco	(Jin 108 x Ica Bunsí) x (Veranic x Cuiñapa 72)	IIG
Quivicán	Blanco	(XAN 273 x SEA 2) F 1 x (OAC 88-1 x NEGRO SAN LUIS) F1) F 1 /-(NN) Q-(NN) C	IIG
Lewa	Blanco	---	INIFAT
Alubia Española E.	Blanco	---	IIG
CUFIG 145	Blanco	(Catrachita x XAN 309) F 1 x ((A 429 x G 13614) F 1 x (J 117 x G 17341) F 1) F 1/(NN) Q-(NN) C	IIG

## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Evaluation of 25 genotypes of vean (*Phaseolus vulgaris* L.) in fragile ecosystem in Granma province.

### How will we evaluate the agronomic value?

The agronomic value of the varieties will be evaluated using the scale from 1 to 5, where 1E (excellent), 2B (good), 3R (regular), 4M (bad) and 5MM (very bad).

The best varieties will be those that obtain evaluations with 1, 2 and 3, the first five varieties of black, 2 red, 1 cream and 1 white seeds will be selected, to be included in the plan of multiplication of seeds of categories and varieties for the productive system of that locality.

## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Evaluation of the agronomic value in commercial varieties of common bean.

No	Identificación	Germination 6 days %	Growth habit	Pods/plant	Seed/Pods	Weight 100 seeds (g)	Kg/ha
1	CC 25-9	98	III	5	6	28	750
2	BAT 304	93	III	7	6	26	983
3	Tazumal	91	II	6	6	26	1267
4	Tomeguín 93	95	II	5	6	34	1223
5	CUL 156	90	II	6	5	28	1030
6	Liliana	36	II	8	6	28	830
7	Triunfo 70	68	II	6	6	28	1080
8	Milagro Villaclareño	93	II	7	7	26	1093
9	Cubana 23	93	II	8	5	30	1200
10	CUFIG 48	90	II	8	6	30	1150
11	Velasco Largo	99	I	5	4	52	957
12	CC 25-9 R	91	III	9	4	32	803
13	Gúamá 23	90	I	6	4	70	783
14	Delicias 364	95	II	6	6	32	1000
15	Rubi	78	II	5	4	50	900
16	Buenaventura	84	II	6	5	36	810
17	CUFIG 110	82	II	5	5	38	463
18	Engañador	98	II	8	5	24	1023
19	Wacuto	100	III	9	6	28	930
20	La Cuba 154	91	III	7	5	34	1247
21	Chévere	61	II	8	6	26	910
22	Quivicán	50	II	11	6	26	993
23	Lewa	62	II	12	5	26	960
24	Alubias Blancas	26	I	11	5	54	640
25	CUFIG 145	30	II	14	5	44	957

## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Evaluation of the agronomic value in commercial varieties of common bean.

Evaluation Scale 1-5									
No	Genotypes	1E	2B	3R	4M	5MM	Total de evaluators	Total evaluators	Order of varieties
1	CC 25-9	3	16	12			31	31	16
2	BAT 304	1	23	7			31	31	22
3	Tazumal	3	24	4			31	31	14
4	Tomeguín 93	1	29	1			31	31	19
5	CUL 156	4	8	16	1	2	31	31	10
6	Liliana	3	16	10	2		31	31	15
7	Triunfo 70	1	25	5			31	31	21
8	Milagro Villaclareño	5	24	2			31	31	7
9	Cubana 23	3	26	2			31	31	11
10	CUFIG 48	9	19	3			31	31	1
11	Velasco Largo	3	25	3			31	31	13
12	CC 25-9 R	1	3	27			31	31	24
13	Gúama 23	4	23	4			31	31	9
14	Delicias 364	7	22	2			31	31	4
15	Rubi		25	6			31	31	25
16	Buenaventura	4	25	2			31	31	8
17	CUFIG 110	6	24	1			31	31	5
18	Engañador	2	16	13			31	31	18
19	Wacuto	1	27	3			31	31	20
20	La Cuba 154	8	21	2			31	31	3
21	Chévere	2	27	2			31	31	17
22	Quivicán	3	26	2			31	31	12
23	Lewa	1	10	16	3	1	31	31	23
24	Alubias Blancas	6	21	4			31	31	6
25	CUFIG 145	8	22	1			31	31	2

## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

Evaluation of the agronomic value in commercial varieties of common bean.

Number	Evaluation Scale 1 - 5					Observations Genotypes ordering
	1 E	2 B	3 R	4 M	5 MM	
1 N	3	16	12			16
2 N	1	23	7			22
3 N	3	24	4			14
4 N	1	29	1			19
5 N	4	8	16	1	2	10
6 N	3	16	10	2		15
7 N	1	25	5			21
8 N	5	24	2			7
9 N	3	26	2			11
10 N	9	19	3			1
11 R	3	25	3			13
12 R	1	3	27			24
13 R	4	23	4			9
14 R	7	22	2			4
15 R		25	6			25
16 R	4	25	2			8
17 R	6	24	1			5
18 C	2	16	13			18
19 C	1	27	3			20
20 C	8	21	2			3
21 B	2	27	2			17
22 B	3	26	2			12
23 B	1	10	16	3	1	23
24 B	6	21	4			6
25 B	8	22	1			2

### Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

#### Capacitacion

60 students of 3- 10 semester of Agricultural Faculty received training about common bean production



### Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

#### Capacitacion

50 local farmers received training about common bean production and 31 participate in genotypes selection



**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**Sowing**



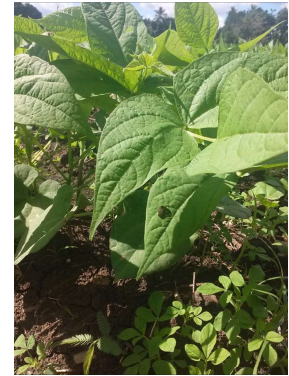
**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**First develop phase**



**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**Second develop phase**



**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**Final phase**



**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**Harvest**



**Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.**

**Genotype selection**





## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

### Genotype selection



## Selection and evaluation of bean genotypes in fragile ecosystems in east region of Cuba.

### Next activities:

1. Continue the training of students and farmers
2. Introduction the new common bean genotypes
3. Testing of common bean genotypes in salt affected soils

## Other activities:

### Congress participation:

TROPENTAG 2018 (17-19 Sept 2018)

VII Cuban Congress of Local Development (26-28 March 2019)

II Convención Internacional y Expoferia Las Tunas 2019 (21 al 23/May 2019)

## Other activities:

### Papers in scientific journals

1. Variabilidad de frutos y plántulas de *Coccoloba uvifera* L. en ecosistemas costeros de Cuba. Cultivos Tropicales journal. No. 1, Vol. 40, 2019 (enero-marzo). **SCIELO database.**
2. Estudio comparativo de la variación de frutos y plántulas de *Coccoloba uvifera* L. en Cuba en base a indicadores morfológicos, ecofisiológicos, fitoquímicos y nutricionales. **In revision.** Revista Mexicana de Biodiversidad. **Web of Science.**

## Other activities:

### PhD and MSc training

1. MSc Mijail Bullain Galardis. PhD student
2. MSc Carlos Avila Amador: PhD student
3. Ing. Luis Saenz Rosales. MSc student



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## Other activities:

### Certificate course topics, type of teaching material

Biodiversity in fragile ecosystems.

Useful microorganisms in the agriculture

- <ftp://ftp.udg.co.cu/pub/Documentos/cursoMaestria.tar.gz>



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**Diversifying cropping systems - Traditional knowledge and innovative approaches. Divecrops  
Workshop 2019**

***Thank you!!***

*Prof.Dr. Raúl Carlos López Sánchez and Prof.Dr. Quirino Arias Cedeño. Granma University*