Influence of Agroforestry Systems with Cacao on Soil Properties (Physical, Chemical and Microbiological)

Selection of cocoa genotypes tolerant to acid soils in Peruvian Amazon

Arévalo – Gardini Enrique[1];
Virupax C. Baligar[2];
Canto-Saenz Manuel[3];
Julio C. Alegre[3].
Arévalo-Hernández Cesar O. [1]

INTERNATIONAL SYMPOSIUM ON COCOA RESEARCH
LIMA - PERU
13 - 17 November 2017

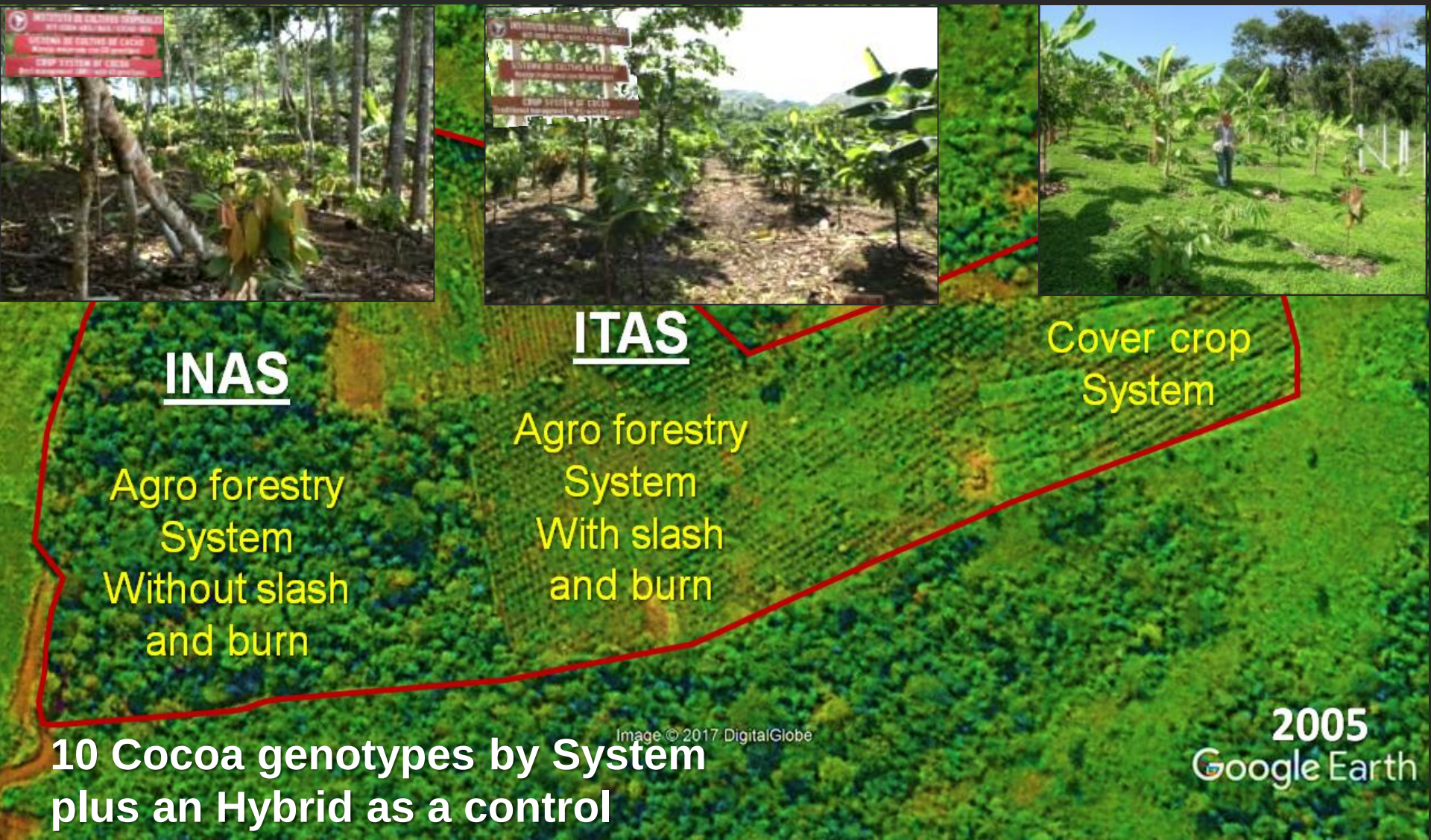
1.Instituto de Cultivos Tropicales, (NAS-ICT) Tarapoto-Peru. enriquearevaloga@gmail.com;
2. USDA-ARS. Belstville, Maryland -USA.
3. Universidad Nacional Agraria la Molina, Lima-Peru

Objective

- To determine the influence of Agroforestry systems with cacao on soil physical, chemical and biological characteristic.
- Select the best cocoa genotype tolerant to acid soils in Peruvian Amazon

Materials and Methods

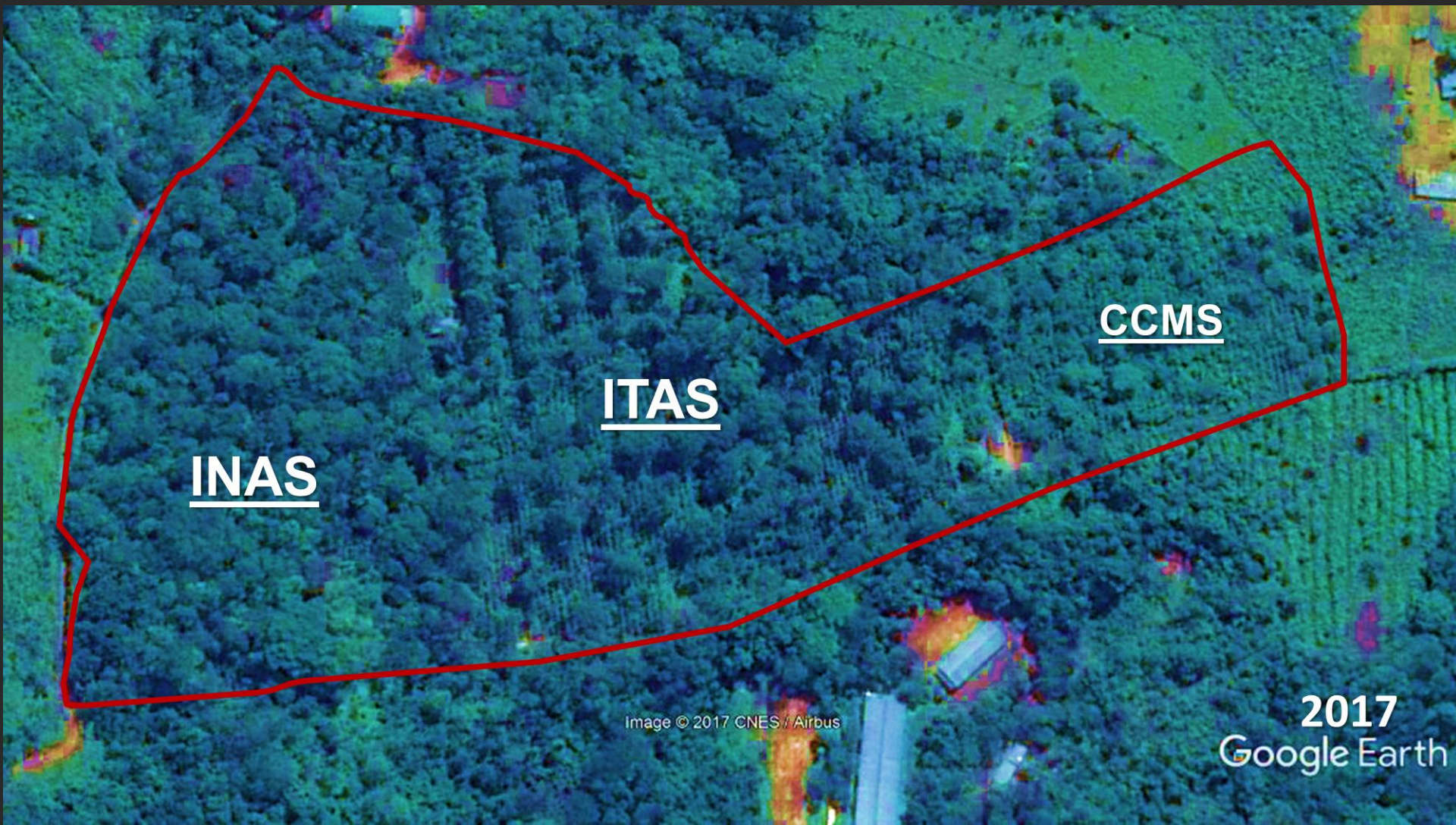
ICT - EXPERIMENTRAL STATION "EL CHOCLINO"
Lat. 06.477° Long. 76.332° 510 m.o.s.l.



10 Cocoa genotypes by System plus an Hybrid as a control

Materials and Methods

ICT - EXPERIMENTRAL STATION "EL CHOCLINO"
Lat. 06.477° Long. 76.332° 510 m.o.s.l.



SOIL SAMPLING AND ANALYSIS

Sampling (0 – 20 cm)

- Arround genotypes

Physical analysis

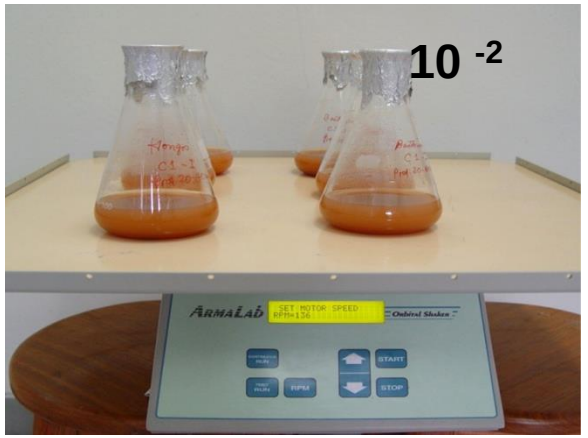
- Texture
- Bulk density,
- Porosity, and soil moisture

Chemical analysis

- pH
- SOM, P, K, CEC
- Bases
- Exchangeables

SOIL FUNGAL ANALYSIS

Soil dilution plate technique

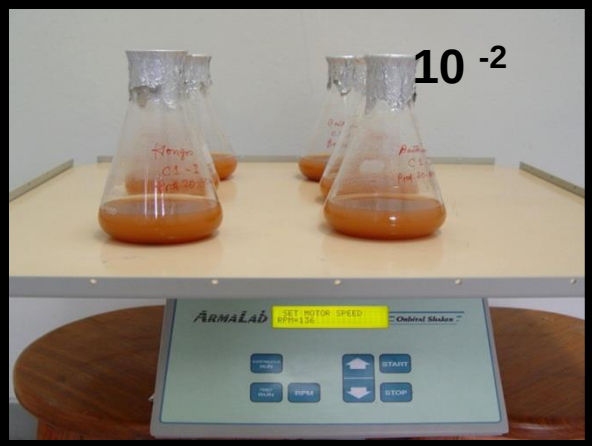


NEMATODES EXTRACTION

Method of Screening (Cobb 1914) and The Tray (Canto 2005)

SOIL FUNGAL ANALYSIS

Soil dilution plate technique



NEMATODES EXTRACTION

Method of Screening (Cobb 1914) and The Tray (Canto 2005)

Genotype for Acid Soil Test

Cacao Colection			
International	**Brasilera**	**ICT**	**Wild**
H-10	IPIRANGA-1	ICT-2173	UNG-76
ICS-6	PH-990	ICT-2171	UGU-126
P-12	PH-17	ICT-2653	AYP-20
UF-667	PH-16	ICT-2172	UNG-73
ICS-39	PH-15	ICT-1092	UGU-130
SCA-6	PH-21	ICT-1292	UNG-77
IMC-67	BN-34	ICT-1112	AYP-15
EET-400	PH-09	ICT-1087	UNG-53
CCN-51	CP-49-C10	ICT-2161	NUC-156
TSH-565	CA-14	ICT-1189	PAS-105
TSH-1188	CP-2005-C10	ICT-1506	PAS-100
CCN-10	PH-144	ICT-1281	AYP-22
UF-613	CP-53-C10	ICT-1251	PAS-93
ICS-95	BS-01	ICT-1026	UGU-112
ICS-1	CEPEC-2002	ICT-2142	PAS-91

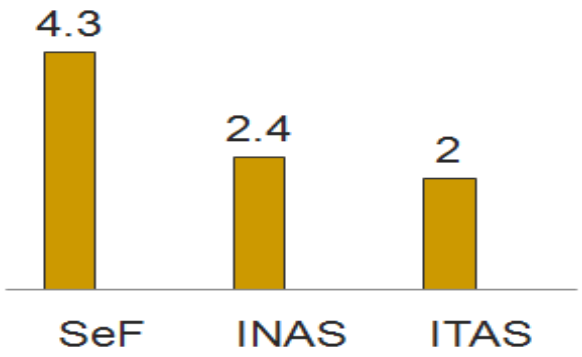
Data registration

- Soil Physical and Chemical properties
- Population of Fungi (cfu gs^{-1})
- Population of Nematodes (individual 100 $gsoil^{-1}$)
- Species Richness
- Shannon Index
- Genotype Tolerance Index for Acid Soils

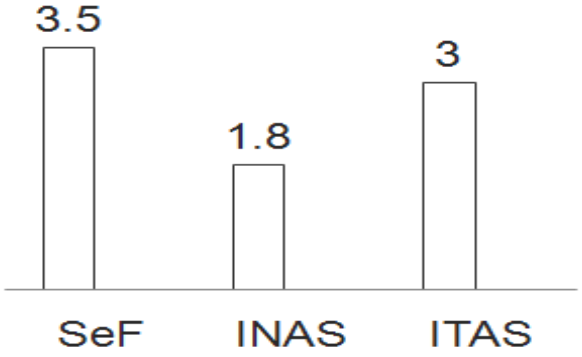

RESULTS

Soil Physical Properties

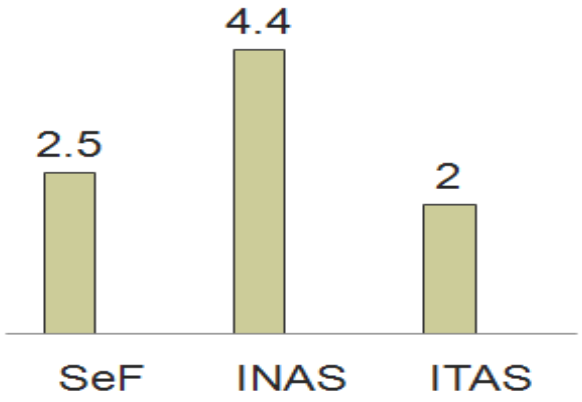
Bulk density (BD) (g cm^{-3})



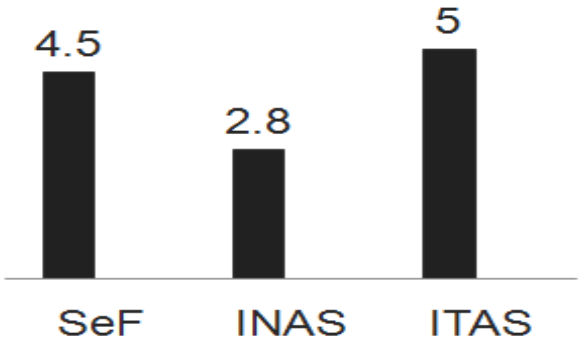
Field Capacity (FC) (%)



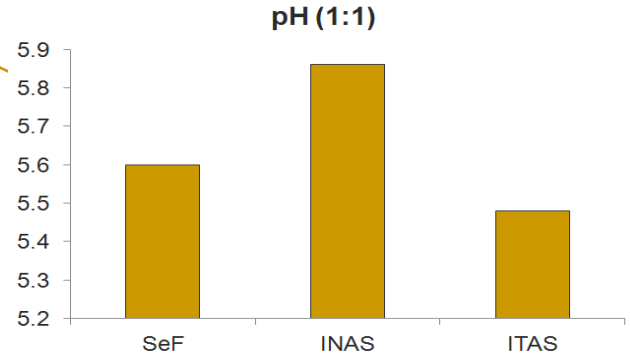
Porosity (Po) (%)

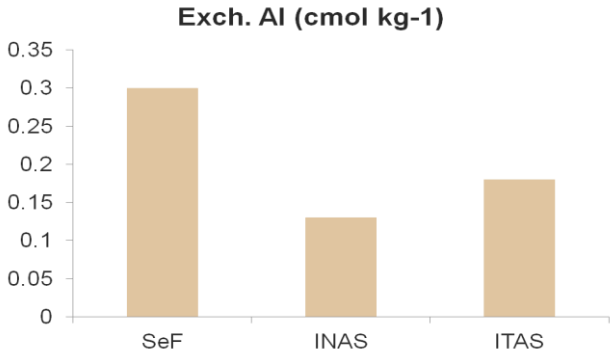


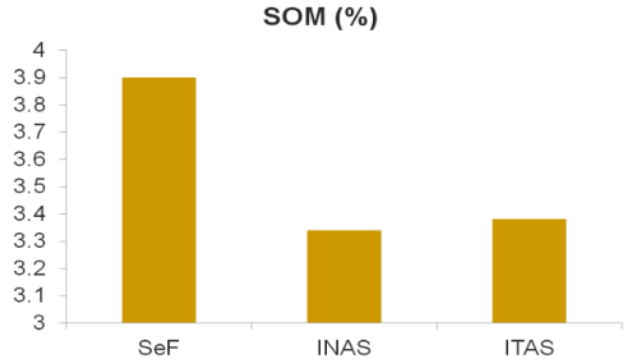
Wilting point (WP) (%)

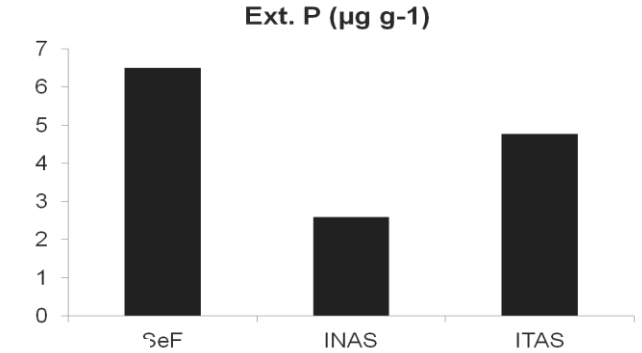


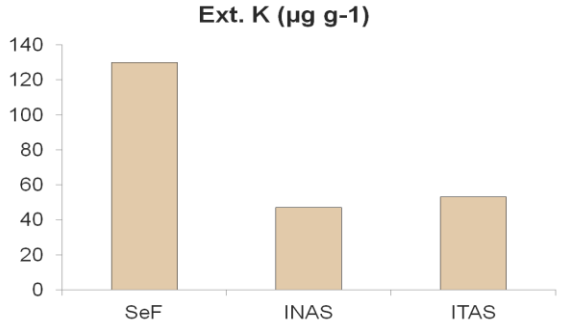
Soil Chemical Properties







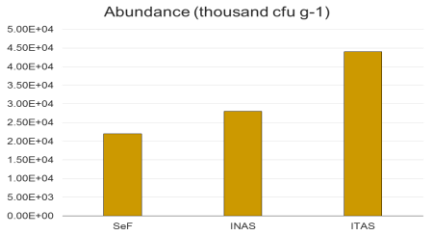


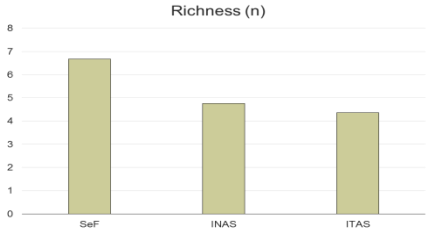


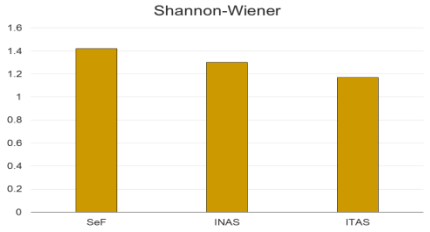
Soil Fungi

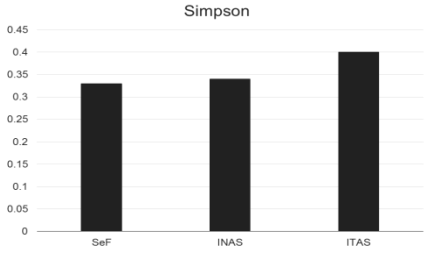
Genera	Functional Group	2004	2012	
		SeF	INAS	ITAS
Clonostachys sp.	BCF	+		
Metarrhizium sp.	BCF		+	
Mycogone sp.	BCF	+	+	+
Paecilomyces sp.	BCF	+	+	+
Penicillium sp.	BCF	+	+	+
Trichoderma sp.	BCF	+	+	+
Bipolaris sp.	PPF	+		
Cephalosporium sp.	PPF	+	+	
Phytophthora sp.	PPF	+		
Rhizoctonia sp.	PPF	+		
Aureobasidium sp.	PSF	+		
Cladosporium sp.	PSF	+	+	+
Cylindrocarpon sp.	PSF			
Fusarium sp.	PSF	+	+	+
Hyalodendron sp.	PSF			
Nigrospora sp.	PSF			
Phialophora sp.	PSF			
Verticillium sp.	PSF	+		
Aspergillus sp.	SF	+	+	+
Chrysosporium sp.	SF	+		
Cunninghamella sp.	SF	+	+	
Didymostilbe sp.	SF		+	+
Eurotium sp.	SF		+	+
Gilmaniella sp.	SF			
Gliomastix sp.	SF		+	+
Mucor sp.	SF		+	+
Neosartorya sp.	SF		+	+
Rhizopus sp.	SF			+
Scolecobasidium sp	SF			
Sterile mycelia	SF		+	+

BCF=Potential biological control fungi, PPF= Potential plant pathogen fungi, PSF=Pathogen-saprophytic fungi, SF=Saprophytic fungi





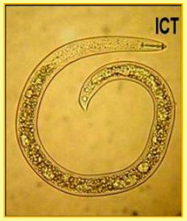




Soil Nematodes

Meloidogyne sp

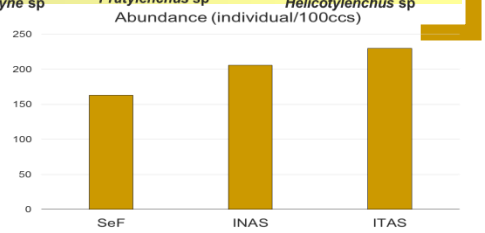
Pratylenchus sp

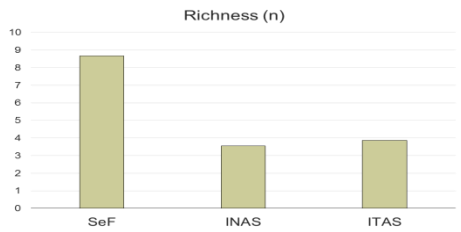


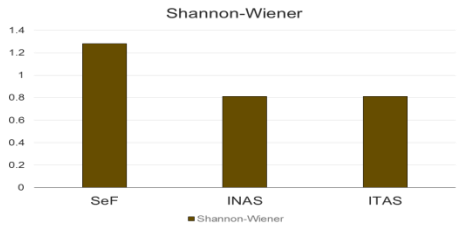
Helicotylenchus sp

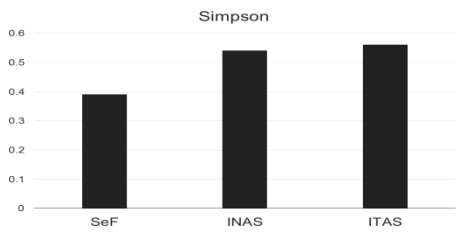
Genera or Family	c-p[a]	GT[b]	2004	2012	
			SF	INAS	ITAS
Rhabditidos	1	BF	+	+	+
Aphelenchoides sp.	2	FF	+	+	+
Aphelenchus sp.	2	FF	+	+	+
Ditylenchus sp.	2	FF			+
Dorylaimidos	4	O-P	+	+	+
Atylenchus sp.	2	PP			
Criconemoides sp.	3	PP	+		+
Crossonema sp.	3	PP		+	+
Dorylaimus sp.	4	PP			
Helicotylenchus sp.	3	PP	+	+	+
Hemicycliophora sp.	3	PP	+		
Meloidogyne sp.	3	PP	+	+	+
Paratylenchus sp.	2	PP	+	+	+
Pratylenchus sp.	3	PP	+		
Psilenchus sp.	2	PP			+
Rhadinaphelenchus sp.	2	PP			+
Rotylenchulus sp.	3	PP		+	+
Rotylenchus sp.	3	PP	+		
Scutellonema sp.	3	PP			+
Trichodorus sp.	4	PP		+	+
Tylenchorhynchus sp.	3	PP		+	
Tylenchulus sp.	2	PP			+
Tylenchus sp.	2	PP	+	+	+
Xiphinema sp.	5	PP	+	+	+
Mononchus sp.	4	PP	+	+	+

[a]c-p = colonizers and persistent, scale 1-5 where 1 is a colonizer of short generational period and 5 are persistent for a long generational period according to Borges, 1990.
[b]GT = Trophic Group: BF = Bacteriophage, FF = Fungivore, PP = Phytophages or plant parasites, O-P = Ommivores-predators; according to Yeates et al. (1993).

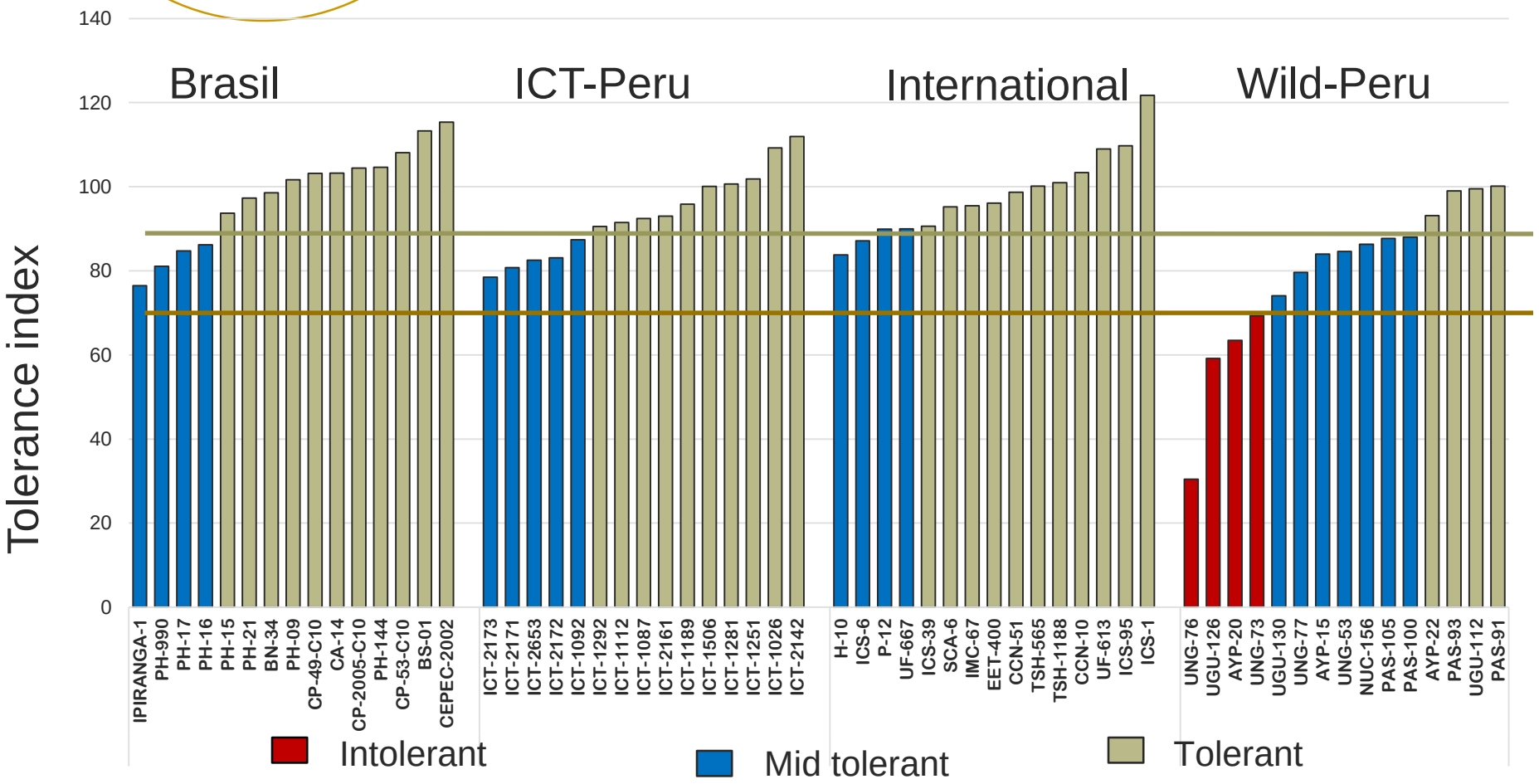








CACAO TOLERANCE TO SOIL ACIDITY



CONCLUSIONS

- The high Shannon index observed in INAS, is evidence that this system has positive effects on population dynamics and richness of soil microorganisms.
- In the ITAS the positive effects only was observed for the nematological diversity
- During the first year of establishment, ITAS has favorable effects on the diversity of biological soil parameters.

Acknowledgment

INSTITUTO DE CULTIVOS TROPICALES
ICT
San Martín - Perú

ONE MISSION - ONE TEAM
NAS
U.S. EMBASSY
LIMA - PERU
UN EQUIPO - UNA SOLA MISIÓN

USDA ars

CITEcacao
Centro de Innovación Tecnológica del Cacao

OAS/OEA
CICAD

InnóvatePerú
FIDECOM
FONDO DE INVESTIGACIÓN Y DESARROLLO PARA LA COMPETITIVIDAD

HOMINEM
COLLEGE CUPIS

UNSM
TARAPOTO
UNIVERSIDAD NACIONAL DE SAN MARTIN

ITP
red CITE
Instituto Tecnológico de la Producción

GRACIAS !