Conservación y Valoración de Recursos Genéticos Microbianos

Seminario Internacional
"Recursos Genéticos para la Alimentación y la Agricultura del Futuro en el Contexto de Cambio Climático"
10 de diciembre de 2015
David Smith

Outline

• Who is CABI
• CABI activities in South America
• microbial domain Biological Resource Centres (mBRC)
• International Networking – common compliant approaches e.g. MIRRI
• Networking in South America
our mission

CABI is a not-for-profit international organization that improves people’s lives by providing information and applying scientific expertise to solve problems in agriculture and the environment.

We work on behalf of 48 member countries.
Global reach We have 480+ staff across 21 locations worldwide

CABI’s business units

Publishing
- Research databases, books, Compendia and Internet Resources, covering:
  - agriculture
  - veterinary science
  - environmental science
    - human health
  - leisure & tourism
  - Knowledge Management projects

International Development
- Trade & Commodities
- Invasive Species
- Development, communication & extension
- Microbial Bioservices

plantwise is a “one CABI” initiative drawing skills and resources from both core businesses
Biological control
Tackling invasive species

- Core activity for over 100 years
- CABI centres in UK and CH
- Unique quarantine facilities
- Working with Governments / national research organizations / educational establishments / non-governmental and community based organizations / the private sector / EC / international agricultural research centres
- UK programmes on Japanese Knotweed and Himalayan Balsam

Invasive Issues

**Food Security**
- Invasive weeds can reduce crop yields and stock carrying capacity by 90%

**Health**
- Major impact on humans and animals

**Gender**
- Weeding is a back-breaking and time consuming task often performed by women

**Trade**
- 40% of EU Border Rejections due to pesticide residues

**Biodiversity**
- Biggest threat after habitat loss
CABI’s food security strategy – lose less, feed more

Over 1300 clinics in 34 countries
Over 2,000 plant doctors trained
Hundreds of thousands farmers helped

Global usage of Knowledge Bank

LOSE LESS, FEED MORE
www.plantwise.org

www.plantwise.org
PW Implementation 2015

Africa
- DR Congo
- Kenya
- Rwanda
- Sierra Leone
- Uganda
- Tanzania
- Ghana
- Zambia
- Malawi
- Mozambique
- Ethiopia

C&W Asia
- Cambodia
- Vietnam
- Thailand

South Asia
- Bangladesh
- India
- Nepal
- Sri Lanka

Caribbean & Central America
- Nicaragua
- Suriname
- Honduras
- Barbados
- Grenada
- Trinidad & Tobago

Latin America
- Bolivia
- Peru
- Brazil

East Asia
- China

SE Asia
- Kwazulu-Natal
- Vietnam

Impact Bangladesh clinics
- 350 farmers interviewed
- Spent less - $16.71 saving
- Over 9% increase in yield
- $325 increase per harvest

Farmers spent the additional money on:
- Children's education: 25%
- Home improvement: 21%
- Investment in the farm: 43%
- Buying a cow: 13%
- Planting: 9%
- Buying land: 9%
- Growing a crop: 7%
- Agriculture: 5%
- Other: 11%

Set up at local meeting places
Receive a diagnosis and a 'prescription' from the plant doctor
Collaboration with EMBRAPA Quarantine laboratories in Brazil

Damage

Palm Pest complex:  
• Red Palm Mite  
• Lethal Yellowing  
• Red Ring:  
  *Rhynchophorus palmarum* + nematode: *Bursaphelenchus cocophilus*
Red Palm Mite Control
Entomopathogenic fungi

- Fungi tested for control:
  Cladosporium, Simplicillium graminicola,
  Penicillium, Cochliobolus, Aspergillus,
  Pestalotiopsis, Fusarium, Pithomyces
  Effectiveness dependant on mite resistance

IPM Package used
Evaluate Beauveria and Metarhizium
Practices to reduce the population of RPM
Efficiency of selected acaricides, abamectin,
fenpyroximate, milbemectin and spiromiclofen
Validate the IPM Package with farmers –
Technology transfer

Insect pathogens from Chilean extremes

Steve Edgington CABI UK-Centre
Surveys of Chile 2007 – Present
Surveys for insect killing microorganisms from extreme habitats in Chile
The objective – to find environmentally fit organisms to control insect pests

Surveys of Chile
Chilean soil samples baited out with waxmoths
1500 soil samples from very north to very south of Chile, from sea level to >4500 m
Chile

Over 600 insect-killing isolates, from a range of habitats. Stored at the Centro Tecnológico de Control Biológico, Chillán.

www.controlbiologicochile.cl

Bioassays

Testing against a range of insect pests in Chile

Collected over 500 isolates of entomopathogenic fungi and 101 isolates of entomopathogenic nematode (including three new species of nematode and one new species of gut-residing bacteria)
CABI Biological Resource Centre

- 28,000 Fungi plus 2,000 bacteria
- 6,000 species; 1,300 ex-type; 20,000 Freeze-dried; 16,000 Cryopreserved; 18,000 Under oil; 1,500 Supplied/yr
- ca. 500 preserved/yr
- 380,000 dried specimens (32,500 species) housed at Kew Gardens

WFCC affiliated collection

Alexander Fleming's strain

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Biological Resource Centre

Their roles include:
- Preservation and supply of biological resources
- Performance of R&D – adding value
- Conservation of biodiversity
- Repositories for protection of intellectual property
- Enabling the tracking of genetic materials

BRCs are compliant with national law, regulations, and policies
Operate to international standards
- Independent third party assessment

Next generation culture collection
Typical income streams

- Government support
- Private industrial support
- Public and private foundation support
- Public fundraising
- Sale of biological resources and technical materials
- Provision of specialist services and technical consulting expertise
- Research income (grants and contracts)
- Fees for repository service (safe deposits and patent strain maintenance)
- Provision of technical courses
- Exploitation of genetic resources

There is not one financial model that can be applied to all culture collections or BRC.

BRCs support the search for active molecules – CABI and partners building capacity in Guyana

2492 cultures (64 taxa) isolates were found to have potent anti-insect activity
potent anti-fungal activity
3 potent anti-bacterial activity
A hit rate of 1 in 3; with 3 molecules ready for development into products

Endophytic fungi isolated from living symptom-less leaves of 12 tree species

Coordinated globally the potential is enormous
PharmaLinks (SIDR, Strathclyde Scotland): who screen culture extracts against an array of assays
Royal Holloway: who provide chemical analysis of compounds using MALDI-MS, NMR, GCMS
Royal Botanic Gardens Kew: a collaboration with the Jodrell laboratory
The British Antarctic Survey: whose collection we have taken in and are jointly exploring

- Tuberculosis (7 strains)
- African Sleeping Sickness (9 strains)
- Parkinson’s disease (1 strain)
- Anti Microbial (3 strains)
- Diabetes (2 strains)

Microbes in biotechnology

- Antibiotics and other drugs
- Biological like insulin, serum antibodies, and essential hormones
- Large scale manufacturing of vaccines against diseases like influenza flu, polio, BCG etc.
- Fermented foods like Yogurt, milk by products like cheese, sweet chocolates and silage
- Probiotics which helps in curing of diseases of digestive systems and intestinal disorders
- Large scale production of food and industrial products e.g. products include, beverages, antibiotics, milk by products
- Polysaccharides, polyamides, polyesters and many other varieties of biopolymers
- Biodegradation, bioremediation, biotransformation are used for cleaning of the environments
- Biotreatment of wastes e.g. removal of heavy metals
- Industrial enzymes and many other products
Global Biotechnology Market to Value USD 414.5 Billion by 2017

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Market (US$ billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalosporins</td>
<td>11.8</td>
</tr>
<tr>
<td>Penicillins</td>
<td>3.57</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>44.68</td>
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<tr>
<td>Antivirals excluding vaccines</td>
<td>10.2</td>
</tr>
<tr>
<td>Quinolones</td>
<td>6.4</td>
</tr>
<tr>
<td>Antifungals and antiparasitics</td>
<td>4.2</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>1.8</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>1.4</td>
</tr>
<tr>
<td>Other antibacterials</td>
<td>6.1</td>
</tr>
<tr>
<td>Other anti-infectives</td>
<td>5.3</td>
</tr>
<tr>
<td>RNA therapeutics market in 2020</td>
<td>1.2</td>
</tr>
</tbody>
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http://www.transparencymarketresearch.com/antibiotic-market.html
http://www.smi-online.co.uk/pharmaceuticals/uk/conference/mai-nano-technology?utm_source=P-162&utm_medium=EM-%205S&utm_campaign=GroupMail

Why do we need networks?

Share tasks and costs – efficiency

Biodiversity challenge is enormous
- Need to focus
- Need to share task

Human Resources
- Taxonomist: the endangered species

Modern technologies
- Partnerships

More demands
- Quality; Legislation; Biotechnology – common approaches

Capacity building
- Facilities; Technologies; Skills; Knowledge; Protocols; Policies
European Strategy Forum on Research Infrastructures (ESFRI)

(ESFRI) offers a strategic instrument to develop the scientific integration of Europe; Microbial Resources Research Infrastructure (MIRRI) is one of 13 pan-European infrastructures in the life sciences area.
Microbial Resource Research Infrastructure

a pan-European distributed research infrastructure for high quality microorganisms, associated data and services for R&D

Preparatory Phase (2012-2015)

16 Partners (dark orange) and 20 Collaborating Parties (light orange), representing 19 countries throughout Europe

2012 2015

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Compliance management

- Quality of science and business
- Standard of services and products
- Legally compliant operational framework
- MIRRI supports best practice in all these areas but specifically through its work packages:
  - Access and Benefit Sharing (ABS)
  - Biosecurity
  - Business models
  - Stakeholder relationships and partnerships
  - Governance
- MIRRI policy must operate at the national, regional and global levels
Convention on Biological Diversity (CBD) – to the Nagoya Protocol

- Main premise of the Nagoya Protocol is:
  - to prevent the utilisation of genetic resources not accessed in accordance with regulatory requirements
  - to support benefit-sharing commitments
  - to improve legal certainty
- Regulation (EU) No 511/2014 enacted 12 October 2014
- Deadlines outside Europe vary
- MIRRI’s Role
  - Environment for compliance
  - Potential honest broker
  - Awareness and Information resource
  - Best practice and conduit to policy makers and regulators

The Nagoya Protocol

- Implemented nationally to different extents in individual countries
- Some regional approaches such as the EU ABS regulation
- Requires:
  - PIC – Prior Informed Consent
  - MAT – Mutually Agreed Terms
  - MTA – Material Transfer Agreement
  - IRCC – Internationally Recognised Certificate of Compliance
- Documents to be lodged with the Clearing House Mechanism with Unique Identifiers
- Requirement for monitoring (checkpoints) and reporting
- Enforcing agencies (National Measurements Office in UK) Fines and imprisonment
- MIRRI mBRC best practice to facilitate compliance
Tools to help

- The CBD web site [http://www.cbd.int/](http://www.cbd.int/) provides information on all signatory/ratified countries
- National Authority Contact point – often out of date
- National Biodiversity Strategy and Action Plan – often missing
- ABS Measures – Regulations where in place - often missing

Tools to help – Clearing House Mechanism
[https://absch.cbd.int/](https://absch.cbd.int/)

- ABS-CH is a platform for exchanging information on access and benefit-sharing
- Each Party to the Nagoya Protocol is required to make available (a) Legislation; (b) national focal point and competent national authority; and (c) Permits or their equivalent issued (PIC and MAT) IRCC – Little in place one year in
Simplified systems of access

- Most EU Member States will grant free access to their genetic resources (but perhaps not Croatia, Hungary, France, Norway and Spain) this moves the focus from access to measures enabling tracking to utilisation triggering benefit sharing
- New Brazilian ABS regulations: Biodiversity Law (Law 13.123)
  1. For access to conduct any activities with Brazilian biodiversity researchers must work in association with a Brazilian institution which will register the research in an electronic system with the Brazilian National Authority (Conselho de Gestão do Patrimônio Genético – CGEN).
  2. Notification to the Brazilian National Authority is required before the economic exploitation of a finished product
  3. The benefits to be shared are pre-determined; monetary benefits, 1% or up to 0.1% fixed by sectorial agreement made to the National Fund for Benefit Sharing – FNRB linked to the Ministry of Environment
  4. A sample of genetic resource involved in access has to be deposited in one of biological collections recognized by CGEN as a Trusted Depositary Collection
  5. The legislation comes into force 180 days after its enactment on 21 May 2015 – ca. October 2015
Microbial Culture Collections operating in Amazon State (Brazil)

1. National Research Institute of Amazonia - Manaus, Amazonas, Brazil
   http://portal.inpa.gov.br/index.php/component/content/article?id=219
   Agro-forestry Microbiology
   Curatores: Dr. Maria A. de Jesus, ranna@inpa.gov.br; Dr. Ceci Sales ceci@inpa.gov.br
   Medical Microbiology
   Curatores: Dr. Mauricio Ogusku, mmogusku@inpa.gov.br; Dr. Antonia Pereira afranco@inpa.gov.br

2. Oswaldo Cruz Foundation – Amazonia - Manaus, Amazonas, Brazil
   http://amazonia.fiocruz.br/pesquisa/colecao
   General Contact: Dr. Ormezinda Fernandes, ofernandes@amazonia.fiocruz.br
   Bacteria Collection of Amazonia
   Curatores: Michele Silva de Jesus; Luciete Almeida Silva
   Fungal Collection of Amazonia
   Curatores: Dr. Ormezinda Fernandes ; Josy Caldas da Silva

3. Federal University of Amazonia - Manaus, Amazonas, Brazil
   Culture Collection DPUA (Focus: Filamentous Fungi – Aspergillus & Penicillium)
   Curator: Prof. Dr. Maria Francisca Simas Teixeira (mteixeira@ufam.edu.br)

Microbial Culture Collections in Chile registered at the WFCC
Microbial Culture Collections in Chile working for the national Network

Chilean Fungal Collection-CCF (WDCM 1077)
Eduardo Alvarez Duarte
ICBM - Facultad de Medicina
Universidad de Chile
Santiago, Chile

Chilean Microbial Genetic Resources Collection-CChRGM (WDCM 1067)
Andrés France
Instituto de Investigaciones Agropecuarias
Chillán, Chile

Chilean Culture Collection of Type Strains-CCCT (WDCM 1111)
Cledir Santos
BIOREN-UFRRO, Universidad de La Frontera
Temuco, Chile

Chilean Culture Collection of Filamentous Fungi and Yeasts-CCHFL
Patricio Godoy
Facultad de Medicina, Universidad Austral de Chile
Valdivia, Chile

Microalgae Collection of Atacama Desert-MCAD
Mariella Rivas,
Universidad de Antofagasta
Centro de Investigación Científico Tecnológico para la Minería
Antofagasta, Chile

Chilean Network of Microbial Culture Collections: Numbers and field of expertise

Culture Collections in Chile registered at the WFCC
- Four Culture Collections
  ca. 3000 strains
- Bacteria, Yeasts and Filamentous Fungi
- Agriculture, Biotechnology, Environmental, and Human and animal healthy related microorganisms

Culture Collections in Chile working for a national Network
- Five Culture Collections
  ca. 2600 strains
- Bacteria, Yeasts and Filamentous Fungi
- Agriculture, Biotechnology, Environmental, Human and animal healthy, and soil mining related microorganisms

Cledir Santos - CCCT, UFRO; Email: cledir.santos@ufrontera.cl
Mariella Rivas - ACF, Uantof; Email: mariella.rivas@uantof.cl
Eduardo Alvarez Duarte - ChFC, Uchile; Email: ealvarezd@med.uchile.cl
Andrés France - CChRGM, INIA; Email: afrance@inia.cl
Patricio Godoy - CCHFL, UACH; Email: patricio.godoy@uach.cl
Future strategy for facilitating biotechnology

- Potential of the yet to be discovered and described
- Targeted isolation
- How to target - identify known organisms with the right chemistry (target molecules) and identify relatives that might have similar properties and their ecosystems and where they can be found
- Identify substrates and ecosystems that may require their associated organisms or inhabitants to have the right chemistry
- Data mining can lead you – Link microbial data to other data – climate, environmental, metabolic, genomic, chemistry, literature, taxonomic hierarchy create the landscape to predict microbial properties
- Rare that collections have all the relevant associated data with holdings and it is too expensive to screen for everything

BRCs and the Bioeconomy

South American node in the Global BRC Network

- Examples of networks in South America in Agriculture
- Agricultural national research institutes (INIA in Chile) under the Procisur organization (http://www.procisur.org.uy/) of the south cone of the American sub-continent
- Start already been made via Darwin initiative funding
- Huge in vestment by Brazilian Government to establish accredited BRCs
- Build on developed skills
Tailored support for BRC development

- Relevant scientific literature
- Operational Manuals e.g. best practice
- Mechanisms for compliance with legislation
- Business plans
- Distance learning
- Formal courses
- Vocational training
- Expert guidance

Creating the GBRCN from Regional Activities

- MIRRI
- USCCN
- ABRCN
- BBRCN
- AMRIM
thank you

David Smith EUK
d.smith@cabi.org