Challenges to collect and use Fungal Pathogens for Weed Biocontrol in Developing Countries

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Outline

- Weed biocontrol in developed / developing countries
- Challenges to collect and export fungal pathogens for biocontrol
  - Case studies India / Brazil
- Challenges to use fungal pathogens as biocontrol agents
  - *Mikania micrantha* / India
  - *Rottboellia cochinchinensis* / Costa Rica
- Opportunities for developing countries
- Conclusions

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INDIA
IRAN
INDONESIA
INDIAN OCEAN
AUSTRALIA
NEW ZEALAND
Greenland
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Weed biocontrol in developed and developing countries

- The “Big Five“
  Carried out the majority of weed biocontrol programmes

- Developing countries have been the source of many agents

Developing countries as a source of fungal biocontrol agents

- **Brazil**
  - *Prospodium tuberculatum* against *Lantana camara* in AUS (2001)
  - *Colletotrichum gloeosporioides* f. sp. *miconiae* against *Miconia calvescens* in Hawaii (1997), Tahiti and French Polynesia (2000)

- **Colombia**
  - *Septoria passiflorae* against *Passiflora tarminiana* in Hawaii (1996)

- **Madagascar**
  - *Maravalia cryptostegiae* against *Cryptostegia grandiflora* in AUS (1994)

- **Mexico**
  - *Phaeoramularia eupatorii-odorati* against *Ageratina adenophora* in SA (1987)
  - *Puccinia abrupta* var. *partheniicola* (1991) / *Puccinia melampodii* (1999) against *Parthenium hysterophorus* in AUS
  - *Phloeospora mimosae-pigrae* (1994) / *Diabole cubensis* (1996) against *Mimosa pigra* in AUS
  - *Entyloma ageratinae* against *Ageratina riparia* in Hawaii (1975), SA (1989), NZ (1998)

- **Turkey**
  - *Puccinia carduorum* against *Carduus nutans* group in USA (1987)
  - *Uromyces heliotropii* against *Heliotropium europaeum* in AUS (1991)

Julien & Griffiths (1998), Barton 2004, Ellison & Barreto (2004)

Weed biocontrol in developed and developing countries

- The majority of weed biocontrol programmes carried out by "Big Five"
- Developing countries have been the source of many agents
- Very few biocontrol programmes have been solely initiated and/or carried out for developing countries
- Biocontrol programmes are often extended from developed countries to developing countries (piggy backing, off-the-shelf agents)

Developing countries as recipients of fungal biocontrol agents

- **Chile**
  - *Phragmidium violaceum* against *Rubus constrictus / Rubus ulmifolius* from Germany (1973)
  - *Uromyces galegae* against *Galega officinalis* from France via Switzerland (1973)

- **India**
  - *Puccinia spegazinii* against *Mikania micrantha* ex Trinidad (2005)
    - *P. spegazinii* subsequently also released in China (2006), PNG (2009), Fiji (2009)

- **Argentina**
  - *Puccinia chondrillina against Chondrilla juncea* from Italy via USA (1982)

Julien & Griffiths (1998), Ellison & Barreto (2004), Ellison *et al*. (2008)

Weed biocontrol in developed and developing countries

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- Many developing countries still do not have: an invasive species strategy or do not enforce it; a list of priority target weeds and / or appropriate management strategies

Challenges to collect and export fungal agents for biocontrol from developing countries

- Pre-CBD (1992): fungi (and insects) associated with non-crop plants (i.e. weeds) no value, possibility to explore and export relatively freely

  - Security issues when collecting
  - Permission to collect and export from relevant countries

- Post-CBD: awareness of value of biodiversity and need for protection; international conventions supported by national legislation

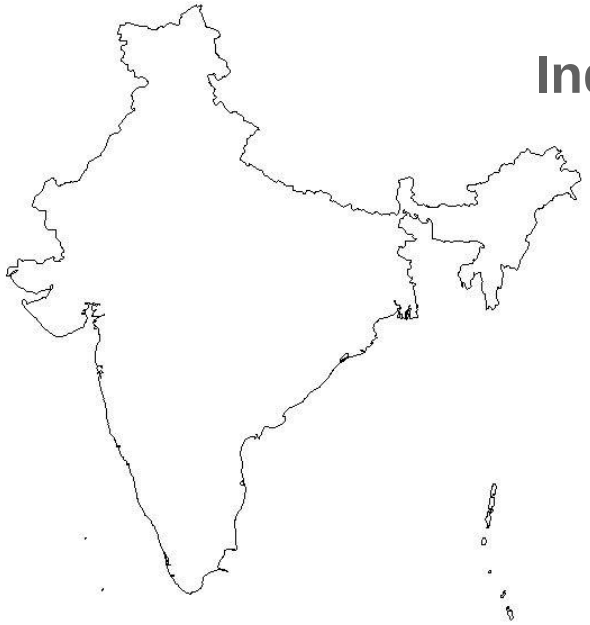
  - No legislation in place yet
  - Relevant legislation inappropriate and/or highly complex; new and not yet fully understood, “biopiracy legislation”
  - Lack of protocols for implementation
  - Responsibilities of government bodies unclear

Challenges to collect and export fungal agents for biocontrol from developing countries (cont.)

- Post-CBD: awareness of value of biodiversity and need for protection; international conventions supported by national legislation

  - Overall reluctance to make decisions by personnel (politicians) in key positions
  - Need to recognise exploration and collection for biocontrol as part of non-commercial research and to separate from profit-orientated commercial research (bio-prospecting) and biopiracy (**A**cess and **B**enefit **S**haring regime)

Challenges to collect / export fungal pathogens for biocontrol



India

Himalayan Balsam
(*Impatiens glandulifera*)

Procedure for export of fungal pathogens from India

- India signing the CBD lead to the Biodiversity Act (2002) governed by the National Biodiversity Authority (NBA)

- Provisions and guidelines in this Act designed to facilitate collaborative research and sharing of genetic resources for scientific purposes

- Application by non-Indian residents to NBA to export genetic material from India against a fee; decision “yes” or “no” ultimate

OR

- Foreign scientists need in-country collaborators within a public-sector organization with legal status and approved by Central Indian Government, signed MoU

- Application for export under a “Material Transfer Agreement” which must be endorsed by an export facilitation committee

- Voucher specimen must be deposited in Indian collection/herbarium

Challenges to collect / export fungal pathogens for biocontrol

Bellyache bush
(*Jatropha gossypiifolia*)

Photo: Kunjithapatham Dhileepan, DEEDI

Phakopsora jatrophicola

Photo: Dartanhã J. Soares
Emprapa Algodão

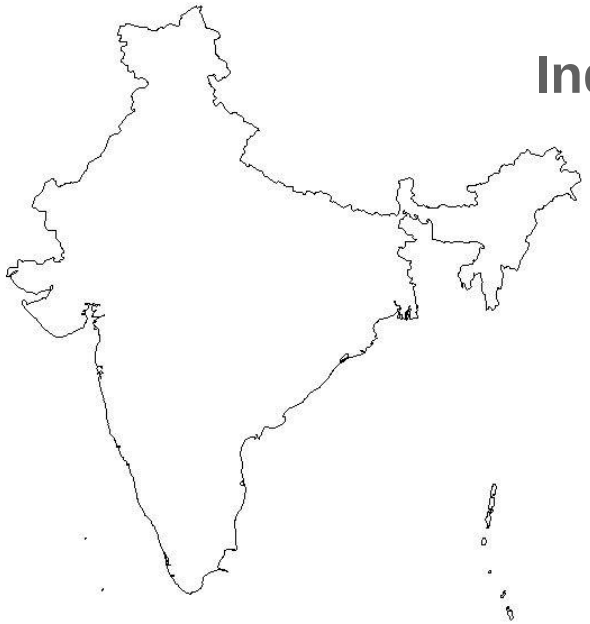
Procedure for export of fungal pathogens from Brazil

- Previously, “illegal collection of biodiversity” was punishable with fines and potential closure of institutions involved
- Work is performed with local Brazilian collaborator as documented by specific paperwork
- Duplicates of specimens are deposited in a Brazilian collection
- Export request filed by local collaborator through the Ministerio de Meio Ambiente (IBAMA) online system
- Within a month of filing the request Brazilian collaborator receives permission document allowing to dispatch or hand-carry the specimen to its destination

Challenges to use fungal agents for biocontrol in developing countries

- Poor donor record in long-term funding for BC programmes for developing world
- Lack of confidence in return on BC programmes
- Piggy-backing on existing programmes in developed world and off-the-shelf agents can give impression BC is a quick solution
- Appropriate policy and legislative frameworks and protocols need to be in place, implemented and followed
- High-grade quarantine facilities expensive to build and maintain
- Reluctance to take decision by relevant authorities/ key personnel
- Pathogens traditionally considered second to insect agents; “pathophobia”

Challenges to use fungal pathogens as biocontrol agents



India

Mile-a-minute weed
(*Mikania micrantha*)

Puccinia spegazinii

Procedure for the importation and release of *Puccinia spegazinii* in India

- Policy frame work in place for import and release of natural enemies, but tailored towards insects
- Stakeholder workshop held in India to gain support for introduction of the rust, workshop recommendations (1999), proceedings published in 2001
- Dossier on prioritized fungal agent *Puccinia spegazinii* and letter stating permission from Ministry of Agriculture, Land and Marin Resources/ Trinidad & Tobago to use their genetic resources submitted to Indian Directorate of Plant Protection Quarantine and Storage (DPPQS)
- Project Directorate of Biological Control (PDBC) of the Indian Council of Agricultural Research (ICAR) entered into project framework
- National Bureau of Plant Genetic Resources (NBPGR) provided quarantine facilities for import of the rust
- Permission to import rust into quarantine after extensive consultation between DPPQS and PDBC (2002)

Procedure for the importation and release of *Puccinia spegazinii* in India (cont.)

- Additional host range testing of rust by Indian scientists from NBPGR and PDBC required before consideration for release (74 species/varieties, 18 repeats of species already tested) completed 2005
- Supplementary Dossier submitted to Plant Protection Adviser to the Government of India, Ministry of Agriculture (MoA) with application for limited field release
- Following extensive consultation between MoA and PDBC permit for release of *P. spegazinii* in two areas each in Kerala and Assam granted (June 2005)

  - Entire biocontrol programme: 9 years
  - Initial Research Phase: 4 years (1996-2000)
  - Consultation, importation, additional research and release of the rust: 5 years (2000-2005)

Parthenium hysterophorus

Puccinia melampodii

Puccinia melampodii* on *Calendula officinalis

Challenges to use fungal pathogens as biocontrol agents

Costa Rica

Itch grass
Rottboellia cochinchinensis

Sporisorium ophiuri

Are there opportunities for developing countries?

- “Enforced” in-country collaboration to gain permission to collect and export
- Benefit-sharing through shared/joint research facilitates the engagement of local expertise and capacity building in-country, technology transfer, chance for local partners to become leaders for biocontrol in their respective country
- Developing countries can piggy-back on biocontrol programmes successfully implemented in developed world – cost-effective way of fast tracking biocontrol
- Developing countries can profit from experience of countries who have long history of implementing biocontrol, from lessons learnt regarding i.e. agent selection and release strategies

Conclusions

- Exploration for and export of organisms for biocontrol needs to be recognized as non-commercial research and to be separated from commercial research (bioprospecting) under ABS
- Biocontrol practitioners will need to comply with country rules to justify confidence placed in them with respect to non-commercial research
- Appropriate legislative frameworks and protocols and in-country knowledge and confidence how to apply these need to be established
- Some countries ahead in facilitating export of beneficials could be role models
- Piggy-backing on biocontrol programmes undertaken in developed countries offers cost-effective fast-tracking for developing countries
- Long-term donor/government funding is crucial for biocontrol programmes targeting primarily developing countries; need for realistic time frames

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