



Insect genetic resources & climate change

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KNOWLEDGE FOR LIFE

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Structure

- Key functional areas
- Effects of climate change on functional areas
- Scope for mitigation using invertebrates
- Genetically modified invertebrates
- Conservation of useful invertebrates
- Transfer of useful invertebrates between countries
- General conclusions
- Priority actions
 - Scientific knowledge gaps
 - Facilitating policy
 - Islands
 - Tropical areas

Key functional areas

- Soil invertebrates
- Biological control agents
- Pollinators
- Invertebrates as food and source of products

Key functional areas

- Soil invertebrates
 - Biological control agents
 - Pollinators
 - Invertebrates as food and source of products
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- Restricted to terrestrial ecosystems
 - Focus on whole organisms (rather than genetic information)
 - Whole organisms have the potential to be used, moved or manipulated to the benefit of agriculture

Soil invertebrates

- Key component of agricultural landscapes, contributing to essential soil processes that maintain healthy productive soils
- Reducing the diversity of a community of soil invertebrates reduces its beneficial functions and services
- The introduction of a keystone species may have detrimental or beneficial effects depending on the context
- Interaction between soil invertebrates and soil micro-organisms is critical

Biological control agents

- Diverse groups of invertebrates provide biological control of crop pests
- Biological control provides the basis of, and tools for, the integrated pest management (IPM) approach
- Losses caused by pre- and post-harvest pests can be very substantial, and are likely to increase as a consequence of climate change, so the potential benefits are vast
- As yet only partially tapped, e.g. the potential of soil invertebrates to assist in this function is still largely unknown

Pollinators

- Pollination services by animals, especially by insects, are widespread and important
- 60–90% of flowering plants – including economically important species – depend on insects for pollination
- Crop pollination used to be (and often still is) provided by wild pollinators from natural and semi-natural habitats
- Farmers in some developed countries can buy or rent managed honeybees or sometimes other species
- Both options have recently come under pressure, a development referred to as the “pollination crisis”.

Effects of climate change - 1

- One pathway by which food security and agricultural production will be influenced by climate change is via its impact on invertebrates
- Single and combined effects are expected from temperature, rainfall, humidity, elevated CO₂, extreme events, as well as their duration and intensity
- Interaction with land-use change (as driven by climate change) also important
- Specific conclusions regarding the impact of climate change on particular elements of invertebrate genetic resources are not possible yet

Effects of climate change - 2

- The crops produced in most regions are expected to change over time as growers select and develop species and varieties that optimize yield and/or economic returns under the prevailing conditions
- The majority of invertebrate pollinators, pests and their natural enemies can be expected to move with their host plants as crop and forage distributions change
- Sub-fossil evidence from the Quaternary Ice Ages suggests that in times of rapid climate change, insects track acceptable conditions rather than evolving *in situ*

Mitigation

- The role of invertebrates associated with agriculture to mitigate climate change is limited
- The amount of carbon in the soil is affected by the action of soil invertebrates and micro-organisms; if these actions could be managed, they might provide a means of reducing atmospheric CO₂
- Soil invertebrates, biological control agents and pollinators will all affect plant biomass and, hence, the amount of carbon fixed in crop plants, but this is only a temporary effect during the cropping cycle

Genetically modified invertebrates

There is little or no scope to use genetically modified invertebrates in agriculture and food (as yet)

Conservation of invertebrate genetic resources

Necessarily based on whole organisms *in situ*

Healthy agro-ecosystems will provide much, but natural habitats as a source of soil invertebrates, biological control agents and pollinators will also be important

Relocation of invertebrates - 1

Soil invertebrates

- Movement of soil invertebrates between countries is not recommended, and there are no suitable guidelines and protocols for this

Biological control agents

- We anticipate increasing demand for the movement of biological control agents between countries to address new pest problems
- Some guidelines and protocols are in place, but implementation the Nagoya Protocol needs to facilitate this exchange

Relocation of invertebrates - 2

Pollinators

- Specialist pollinators have only been moved between countries to a very limited extent, using the procedures and protocols of weed biological control
- Movement of social bees, such as honeybees and bumblebees, between countries has been implicated in the spread of pests and diseases, and improved guidelines and protocols may be needed
- Domestication of wild pollinators is likely to lead to increased movement of new species between countries, and guidelines and protocols for this will be needed

General conclusions

It is likely that climate change will disrupt the use of invertebrates in agriculture, although the precise nature of the disruptions is not yet known

Without intervention, these disruptions will result in production losses (and gains), although the scale and extent of the losses (and gains) is not yet known

The extent of some of the losses will require intervention to facilitate adaptations of the relevant invertebrates

The methods for these interventions have not yet been developed, and policies to facilitate them are not yet in place

Priority actions ...

- Scientific knowledge gaps
- Facilitating policy environment
- Island issues
- Tropical issues

Scientific knowledge gaps

- Taxonomy and genetic characterization of the invertebrates of agro-ecosystems
- Improvement of understanding of arthropods supporting agriculture and their contribution to crop production
- Quantification of the responses of invertebrate species, communities, food webs and their various interactions to climate change-related factors
- More studies on the rates of movement of key species

Facilitating policy environment

- Further development and implementation of existing national biodiversity programmes
- An overarching holistic strategy that integrates invertebrates with other ecosystem components to better design and manage agro-ecosystems
- Guidelines for facilitating and regulating the movement of beneficial invertebrates between countries, building on what is already available
- Implementing the Nagoya Protocol to take into consideration the need for invertebrate genetic resources to sustain agriculture, food production and world food security

Island issues

- Policy support for island states, which will probably not be original sources of biological control agents (or pests) but will need new biological control agents

Tropical issues

- Further investigation of past climate change in tropical areas, to assess how invertebrate species have responded in terms of distribution
- Testing the hypothesis that tropical species may be more sensitive to climate change as a result of narrower biotic ranges and lack of exposure to climatic variation

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