

Insect biodiversity for sustainable management of natural resources

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The conservation of biodiversity and the sustainable use of natural resources are guiding principles of the CGIAR and a recognized thematic priority area. The CGIAR is a major player in the collection, characterization, and unrestricted distribution of agrobiodiversity resources and related information on a global scale. Currently, out of 15 centers, 11 house important genebanks amounting to some 650,000 accessions. These provide scientists with the genetic material needed to significantly increase agricultural productivity.

The conservation of genetic resources at IITA is particularly broad in coverage. Thus, collections encompass a wide range of organisms including plants but also associated nonplant biodiversity. Emphasis is placed on the *ex situ* preservation of plant genetic material. This is reflected in the maintenance of roughly 28,000 germplasm accessions from 19 agricultural crops and their wild relatives. More than half of the genebank's holdings represent in-trust collections of cowpea for which IITA has received the world conservation mandate. Free and unrestricted public access to this genetic material is ensured through institutional compliance with the international seed treaty developed through the Food and Agriculture Organization with the strong involvement of the CGIAR centers.

Apart from the use of genetically improved crops, agricultural productivity is also strongly influenced by a rich in-field biodiversity comprising organisms such as fungi, bacteria, viruses, nematodes, mites, and insects. Their beneficial or deleterious impact on

crops is relatively well understood when interactions are based on simple associations of organisms. However, when many players are acting sometimes across several trophic (nutrition or feeding) levels, the study of ecosystems becomes complicated and knowledge-intensive.

Generally, a thorough inventory and characterization process is the requisite condition for the sustainable management of this nonplant biodiversity. Related information is primarily stored in research collections to which IITA has been giving growing attention over the last decade. Today, important nonplant collections allow safe diagnostics of plant pathogenic microorganisms used for resistance screening in breeding programs and arthropods/fungi used for biological control (see Korkaric and Beed, this issue).

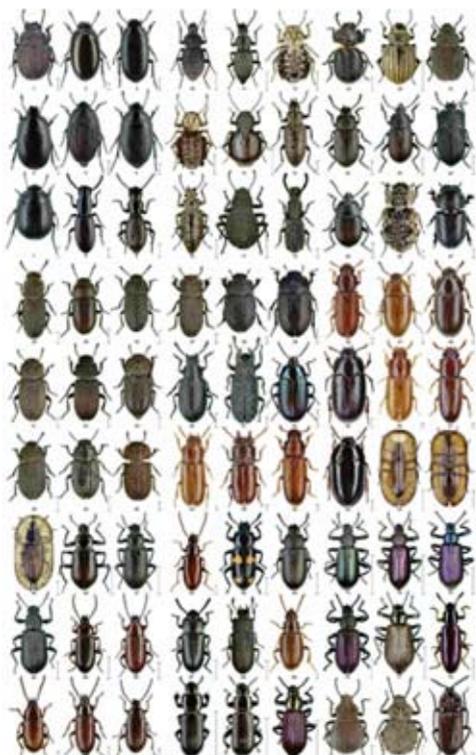
A collection that has particularly expanded over the last 15 years is the arthropod reference collection at IITA-Bénin, the largest within the whole CGIAR. It encompasses currently more than 350,000 specimens collected in a wide range of agricultural and natural environments throughout West Africa. More than 5,000 species from 330 arthropod families have been identified from the sampled material, but it is estimated that about 40–50% of all known insect biodiversity of the subregion is preserved in this collection, awaiting further study. Serving as the coordination center for the West African node of the global taxonomic network BioNET-INTERNATIONAL, this biodiversity collection is well placed to provide essential services



for sustainable natural resource management at the regional level.

The most important service has been the assistance in arthropod identification. Similar to the safe characterization of germplasm when plant material is transferred under the International Treaty on Plant Genetic Resources for FAO, users need reliable and valid entity names for biodiversity monitoring, pest management, biological control, conservation, and compliance with trade-related controls under the prevailing Sanitary and Phytosanitary regulations of the World Trade Organization.

For scientists, farmers, extension and biosecurity agents, quarantine authorities, and any other user throughout the globe, accurate



Insect diversity: Tenebrionidae family checklist.
Photo by Georg Goergen, IITA.

and timely identification is vital. It represents the unique entry point for access to existing information about any organism. Opportunities in West Africa similar to diagnostics services for plant diseases for identifying arthropods are scarce or nonexistent and fees requested by overseas centers of expertise are not affordable for most local users. Thus, by providing the names of, on average, 1,500 submitted arthropod specimens per year, IITA has been instrumental in responding to the regional need for over a decade.

Arthropods form the bulk of the roughly 1.8 million species that have been described until today. It is estimated that this number actually represents only a small fraction of all living organisms, the number of yet unnamed species being particularly large in tropical countries. Thanks to regular faunistic activities, IITA has contributed to the discovery and description of more than 120 arthropod species previously unknown to science. Among them are important pests and their natural enemies.

Following climate change, invasive alien species (IAS) are widely regarded as the second-greatest threat to biodiversity worldwide. They represent a growing concern for biosecurity and quarantine services, especially since increased trade and travel are expected to accelerate the rate of pest introductions. For tropical Africa, data sampled over 100 years show a rate of three introductions every two years. The failure to recognize IAS may have dire economic or ecological consequences. Prevention or early detection of such IAS requires considerable knowledge of native and exotic fauna.

For West Africa, IITA-Bénin is at the forefront of IAS surveillance with the detection of the whitefly *Paraleyrodos minei* Iaccarino, the Sri Lanka fruitfly *Bactrocera invadens* Drew et al., and lately the papaya mealybug



Immature of the whitefly Paraleyrodes minei.
Photo by Georg Goergen, IITA.



Infestation of the papaya mealybug Paracoccus marginatus. Photo by Manuele Tamo, IITA.

Paracoccus marginatus Williams & Granara de Willink (see photographs). Such monitoring also led to the recent detection of a new cashew pest, now awaiting description.

Despite the need to maintain the present services and the opportunities arising to work in new fields, the future of the collection remains unsure because of the lack of external funding. This is all the more surprising since new opportunities for the delivery of public goods are now appearing in various areas with significant impact for the sustainable use of natural resources. Thus, the comparatively young age of the collection makes it particularly well suited for the application of novel identification methods such as DNA barcoding.



Adult female of the Sri Lanka fruitfly Bactrocera invadens. Photo by Georg Goergen, IITA.

IITA's participation could thereby provide important additions to this publicly accessible DNA database thus advancing the goals set by the Consortium for the Barcode of Life (CBOL). Besides agricultural pests and their natural enemies, this technology will also target crop pollinators because of their vital services to ecosystems and the particular concern raised by their global decline. Thus, a full return from past collection efforts will be achieved by applying molecular techniques.

Opportunities to extend biosystematics services at IITA are manifold and crucial for the region that is known to suffer from scanty local capabilities. These include the development of web-based products, the integration of Geographical Information Systems, the provision of online identification tools using high resolution images of important West African arthropod species, and capacity building in the identification of agriculturally relevant groups at various academic levels.

IITA has already an undeniable comparative advantage in biosystematics. This advantage should be preserved in view of its vital support to the successful deployment of plant genetic material for improving food security and reducing poverty in developing countries.