Preventing the transboundary spread of pests and pathogens through germplasm phytosanitary management

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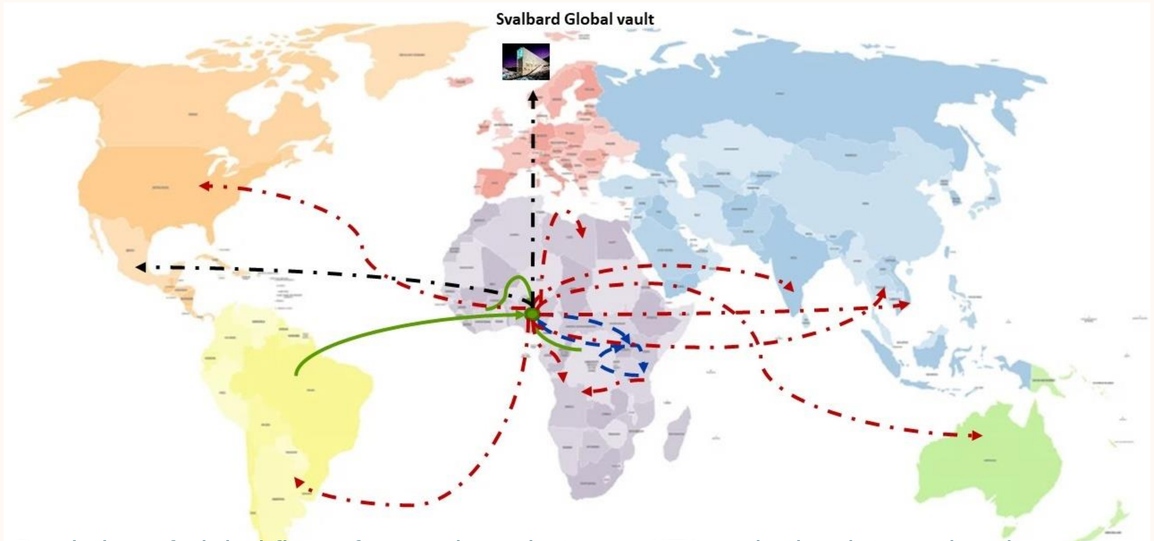
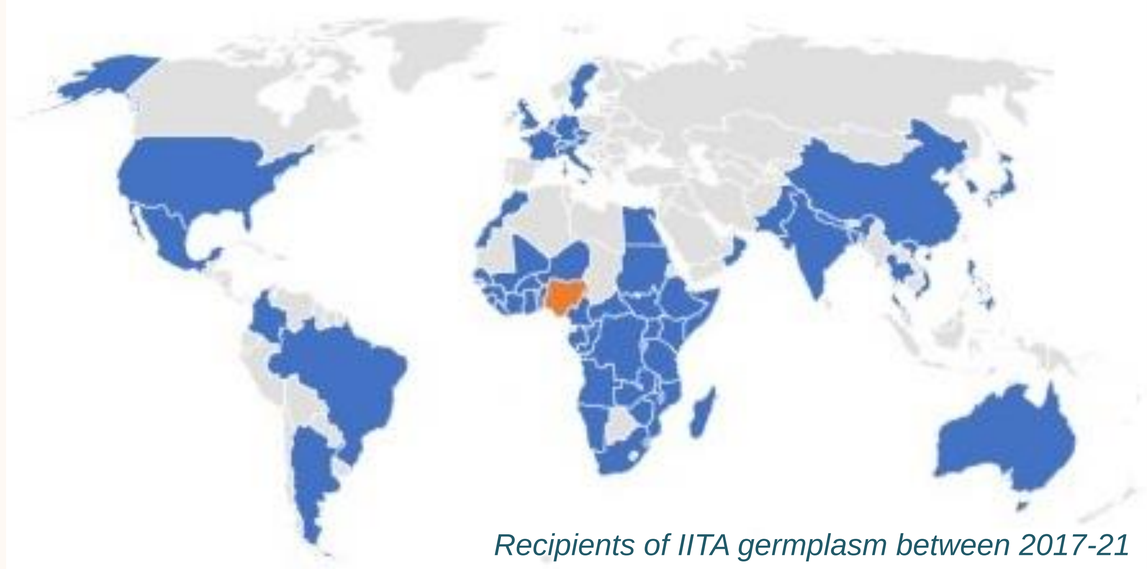


Depiction of global flow of germplasm between IITA and other international programs



Recipients of IITA germplasm between 2017-21

Introduction

Many introduced pests (=pathogens, pests, and weeds) are responsible for major crop disease epidemics. Some examples are maize chlorotic mottle virus, responsible for the lethal necrosis, banana bunchy top virus, fall armyworm, and many others[1]. The estimated economic impact of introduced pests on Africa's agricultural sector was up to US$3.6 trillion per year[2]. Of many pathways for the transboundary pest introduction, seed transmission of pests, along with the international distribution of plant propagation materials, is a major risk for germplasm distribution activities of IITA. As a pest risk mitigation measure, IITA established Germplasm Health Unit (GHU) to facilitate germplasm production free of harmful quarantine pests for conservation and international distribution and comply with national and international quarantine procedures (Fig. 1).

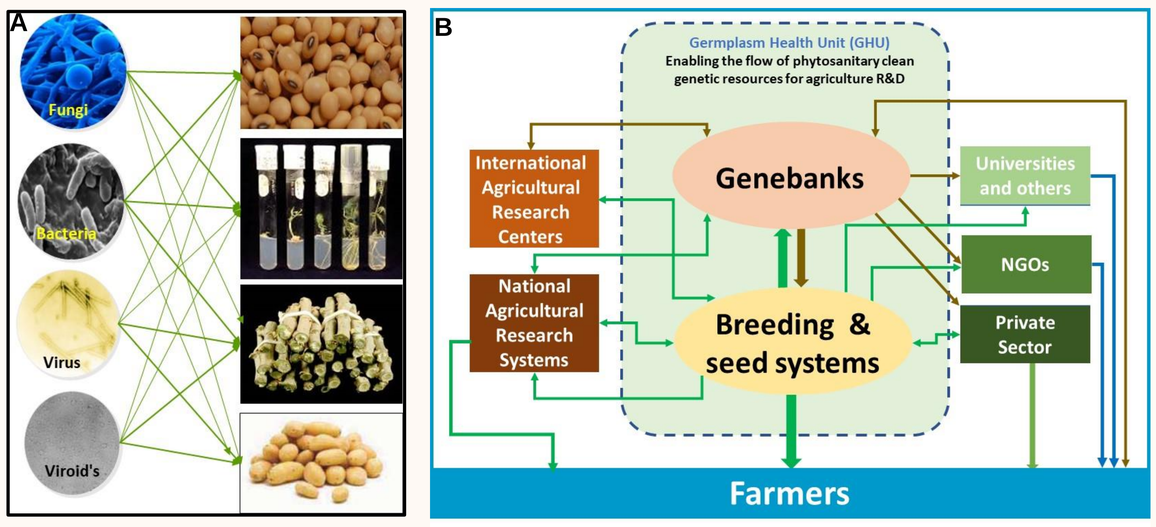


Fig. 1. (A). Seed-borne pest risks; (B) Germplasm distribution pathways and the GHU interventions to prevent transboundary pests.

GHU's multidisciplinary approach

GHU uses a multidisciplinary and multistage process for ensuring phytosanitary safety: seed health testing using a range of diagnostics (bioassays, ELISA, PCR, and isothermal amplification methods (RPA and LAMP), and or sequence-independent high-throughput sequencing (HTS) and bioinformatics virus detection. Phytosanitation (treatment) of germplasm as a curative procedure to eliminate pests and salvage germplasm; and documentation for traceability and regulatory compliance, includes permits issued by the NPPO.

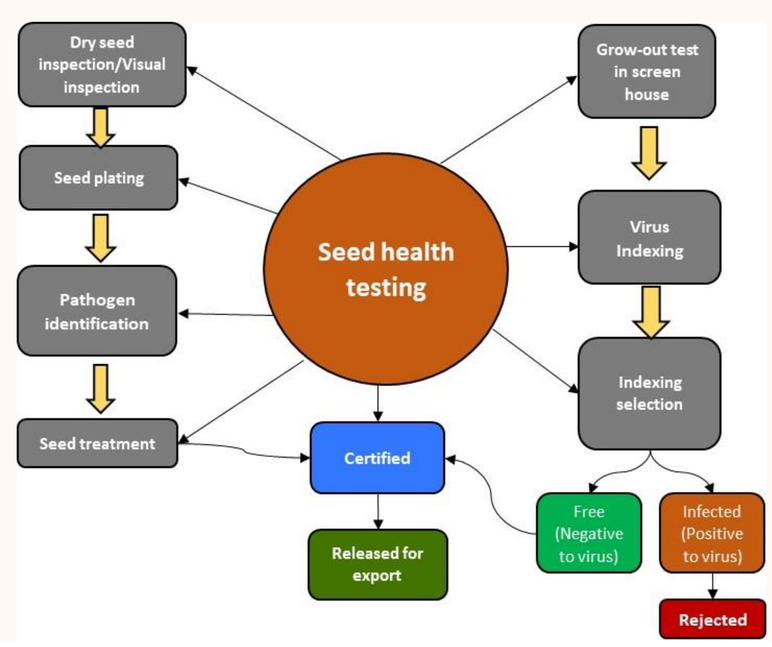


Fig. 2. Outline of the germplasm health assurance and seed phytosanitary scheme used in GHU

Germplasm health assurance

A summary of the sub-set of IITA germplasm processed in GHU between 2017 to 2021 us given in Table 1. Pest-affected germplasm was subjected to phytosanitary treatment, and the cured germplasm was facilitated for global distribution. Germplasm that can not be treated or cured (e.g., virus-infected germplasm) is returned for regeneration of clean plants. Most of the rejected germplasm is contaminated with viruses.

Table 1. Summary of germplasm tested for pests between 2017-2021

Crop	Samples tested	Number of diagnostic reactions	Samples rejected	Samples rejected
African yambean	8,313	17,298	293	3.5
Bambara groundnut	14,762	20,514	1,246	8.4
Banana	842	1,148	145	17.2
Cassava	36,635	24,788	873	2.4
Cowpea	412,670	392,451	35,554	8.6
Maize	99,014	50,683	-	0.0
Other legumes	24,702	-	1,824	7.4
Soybean	102,325	46,988	2,998	2.9
Vigna spp.	1,884	7,273	133	7.1
Yam	4,896	8,011	1,330	27.2

Conclusions

- Between 2017-21, GHU tested about 700,00 samples of 15 species and eliminated 8% of pest-contaminated samples that could not be curated using phytosanitary treatments.
- Most rejected samples were contaminated with viruses, including those restricted by quarantine orders and a few cryptic viruses.
- Used about 560,000 diagnostics tests, which cost an average of US$10 per sample (US$ 5.6 million over five years).
- GHU distributed safe germplasm to 69 countries and prevented the transboundary spread of quarantine pests with IITA activities.
- GHU work makes the most important contribution to national biosecurity. In 2021, the Nigerian Agricultural Quarantine Service (NAQS) recognized IITA for contributing to the NAQS mission.

Fig 3. IITA management team and GHU team with NAQS award

References

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