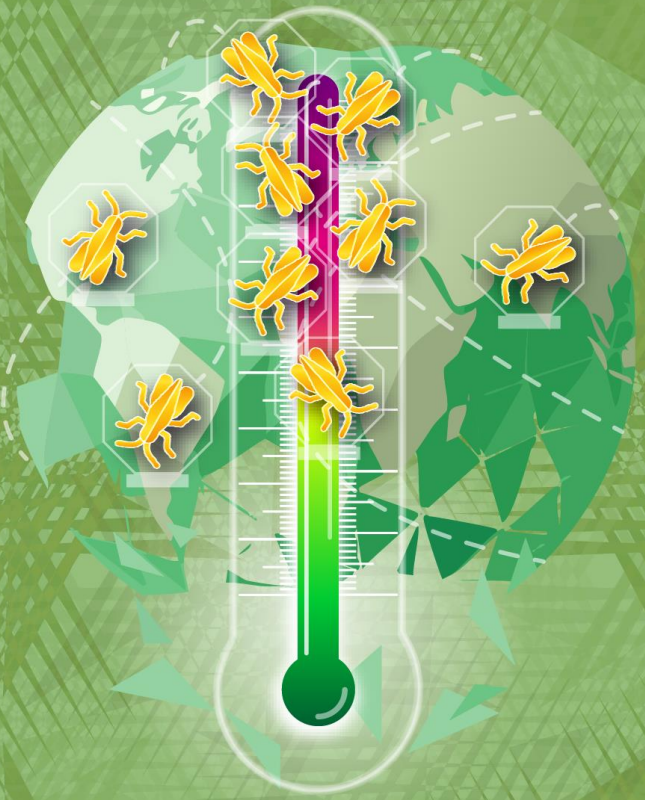
IPPC Webinar Series

Climate Change and Phytosanitary Issues

1–2 October 2025 | 14:00–16:00 CET



Integrated Pest Management in Common Bean (*Phaseolus vulgaris)* under Climate Change

Warren Arinaitwe, Scientist, Alliance Bioversity-CIAT| Bean Program/PABRA, Nairobi, Kenya

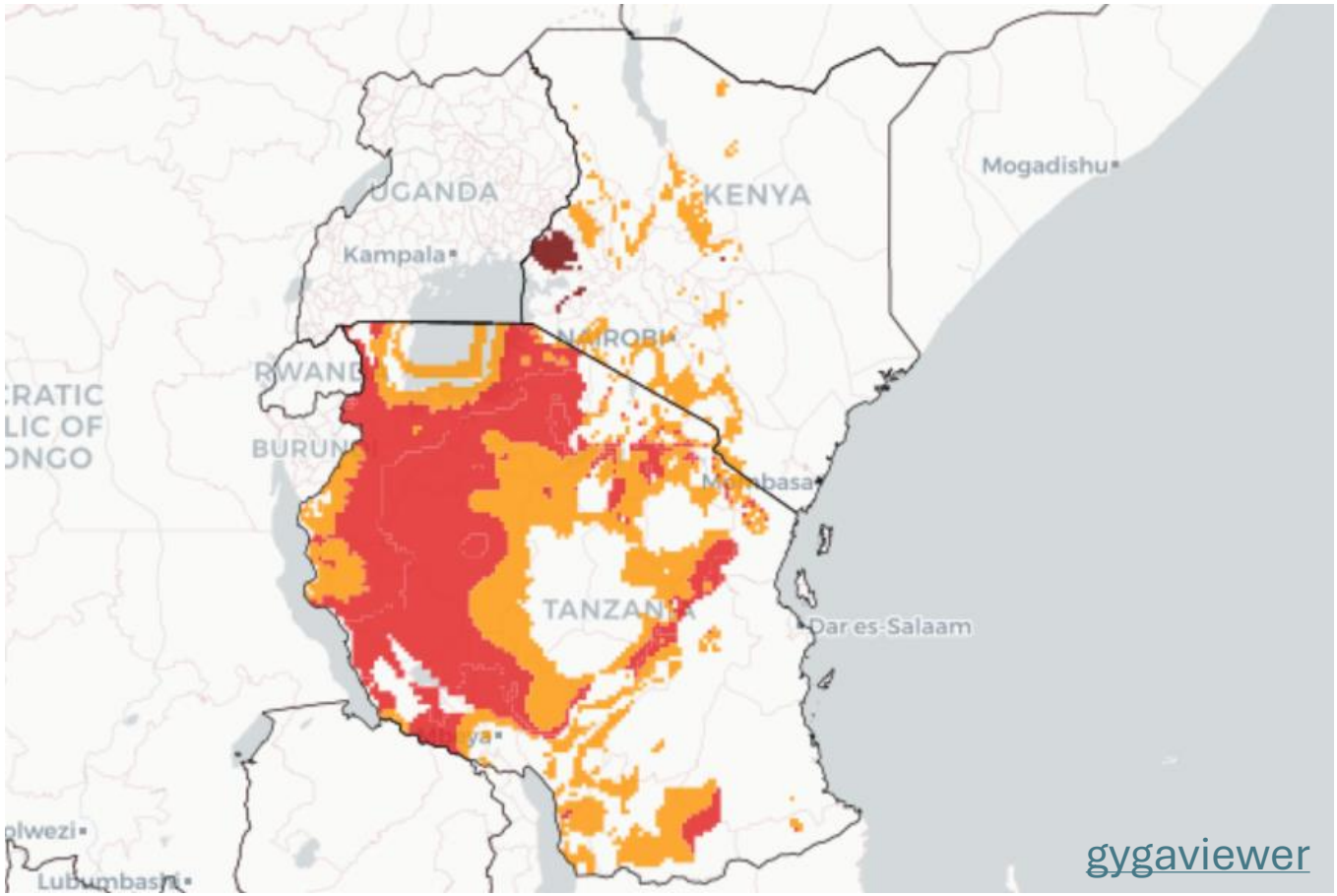
w.arinaitwe@cgiar.org

The common bean yield gap crisis- exacerbated by complex biotic (pathogens) and abiotic stressors

Country	Actual Yield (t/Ha)	Potential Yield (t/Ha)	Yield Gap (%)
Kenya	1.0	2.5	60.0
Uganda	1.2	3.0	60.0
Tanzania	0.8	2.9	72.4
Rwanda	1.1	2.8	60.7
Malawi	0.9	2.6	65.4

Note: The figures are averaged for 10 years (2015-2024), Source FAO

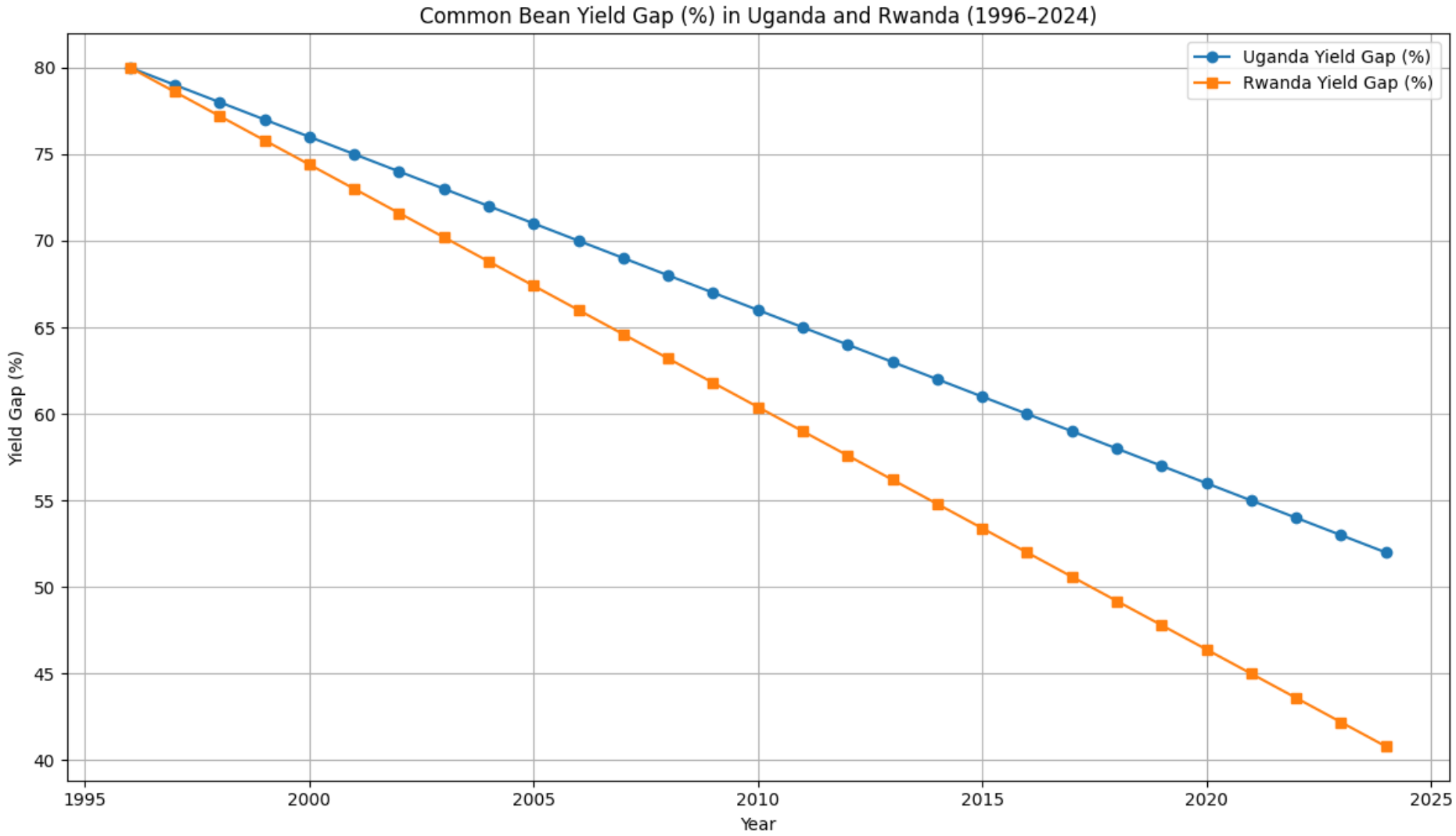
Yield gap can vary within a specific geography



%		%
up to 10 %		50 % - 60 %
10 % - 20 %		60 % - 70 %
20 % - 30 %		70 % - 80 %
30 % - 40 %		80 % - 90 %
40 % - 50 %		more than 90 %

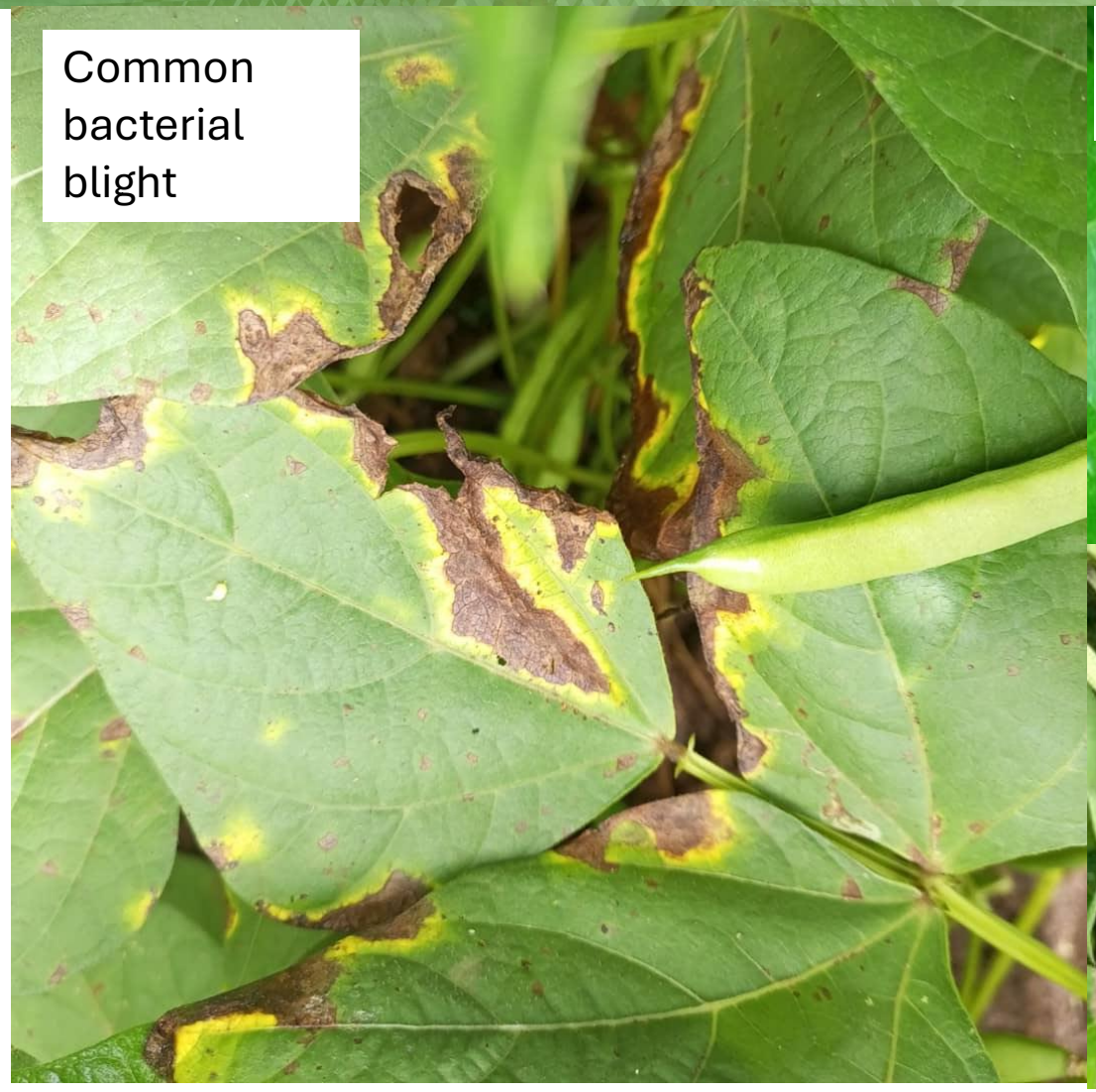
- **Site-specific yield gap depicts localised complexities of production and climate-associated constraints**

Substantial progress has been made in reducing the yield gap in the last 30 years.



Major biotic contributors to the yield gap: Fungal

Blights



Viruses

- Bean common mosaic virus (BCMV)
- Bean common mosaic necrotic virus (BCMNV)
- Cucumber mosaic virus (CMV)
- Bean golden mosaic virus (BGMV)
- Bean golden yellow mosaic virus (BGYMV)

Review

The Complex Interactions of Common Bean (*Phaseolus vulgaris* L.) with Viruses, Vectors and Beneficial Organisms in the Context of Sub-Saharan Africa

Trisna D. Tungadi [1], Francis O. Wamonje [2], Netsai M. Mhlanga [2], Alex M. Murphy [3], Warren Arinaitwe [4] and John P. Carr [3,*]

[1] School of Life Sciences, Keele University, Keele, Newcastle ST5 5BG, UK; t.d.tungadi@keele.ac.uk
[2] National Institute of Agricultural Botany, East Malling, West Malling, Kent ME19 6BJ, UK; francis.wamonje@niab.com (F.O.W.); netsai.mhlanga@niab.com (N.M.M.)
[3] Department of Plant Sciences, University of Cambridge, Cambridge CB2 3EA, UK; amm1013@cam.ac.uk
[4] International Centre for Tropical Agriculture (CIAT), Nairobi P.O. Box 29053, Kenya; w.arinaitwe@cgiar.org
* Correspondence: jpc1005@cam.ac.uk

Abstract

Common bean (*Phaseolus vulgaris* L.), the world's most widely grown legume crop, is not only of great commercial importance but is also a vital smallholder crop in low-to-medium-income countries. In sub-Saharan Africa common bean provides consumers with a major proportion of their dietary protein and micronutrients. However, productivity is constrained by viruses, particularly those vectored by aphids and whiteflies, and problems are further compounded by seed-borne transmission. We describe common bean's major viral threats including the aphid-transmitted RNA viruses bean common mosaic virus and bean common mosaic necrosis virus, and the whitefly-transmitted begomoviruses bean golden mosaic virus and bean golden yellow mosaic virus and discuss how high-throughput sequencing is revealing emerging threats. We discuss how recent work on indirect and direct viral 'manipulation' of vector behaviour is influencing modelling of viral epidemics. Viral extended phenotypes also modify legume interactions with beneficial organisms including root-associated microbes, pollinators and the natural enemies of vectors. While problems with common bean tissue culture have constrained transgenic and gene editing approaches to crop protection, topical application of double-stranded RNA molecules could provide a practical protection system compatible with the wide diversity of common bean lines grown in sub-Saharan Africa.

check for updates

Academic Editors: Marcin Kozak and Ewa Szpunar-Krok

Received: 30 July 2025
Revised: 19 August 2025
Accepted: 22 August 2025
Published: 25 August 2025

Insect vectors

Whiteflies (*Bemesia tabaci*) known to transmit many geminiviruses, including BGMV, BGYMV, and bean yellow disorder virus

Bean aphid (*Aphis fabae*), which vectors BCMV, BCMNV, and CMV

Other destructive insects

Bean fly complex

Sting bug

Bruchids

Strategies Deployed to achieve sustainable IPM

People

Building **identification** capacities within national research systems (NARS)

Infrastructure

Strengthened research infrastructure capacities for **breeding** for genetic resistance

State-of-the-art CGIAR facilities in Uganda, Tanzania and Malawi complement NARS systems

Automate data capture to accelerate breeding at scale with precision

Tumaini Bean: AI-Powered tools for disease detection in common bean

scientific reports

Explore content · About the journal · Publish with us

nature > scientific reports > articles > article

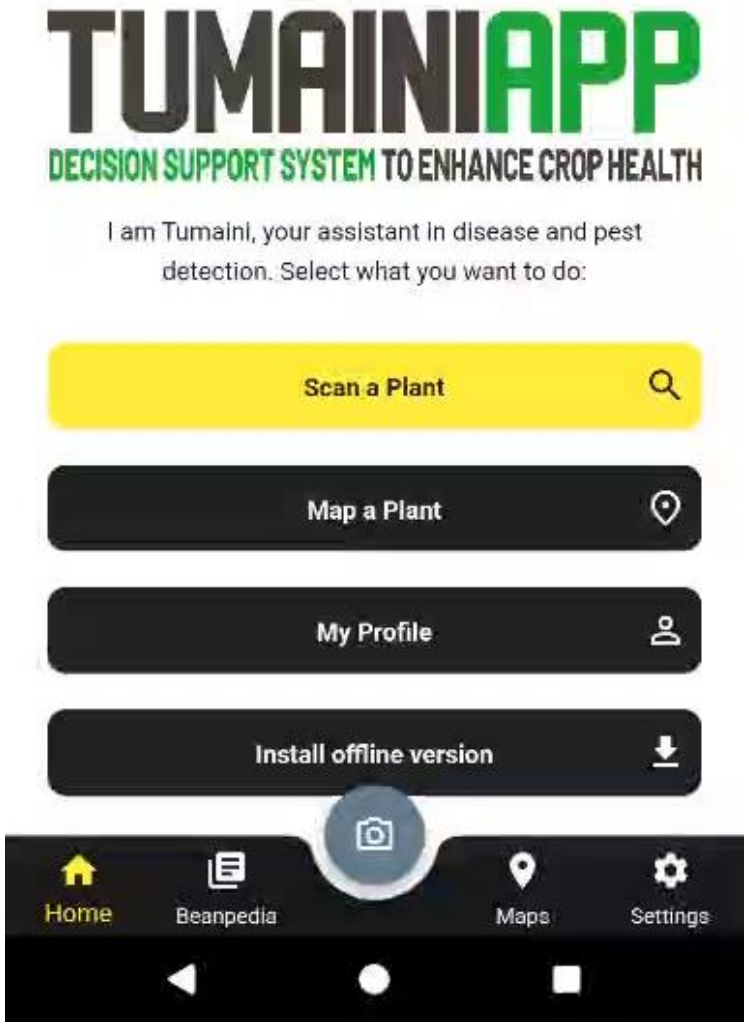
Article | Open access | Published: 06 July 2024

Advancing common bean (*Phaseolus vulgaris* L.) disease detection with YOLO driven deep learning to enhance agricultural AI

Daniela Gomez, Michael Gomez Selvaraj, Jorge Casas, Kavino Mathiyazhagan, Michael Rodriguez, Teshale Assefa, Anna Mlaki, Goodluck Nyakunga, Fred Kato, Clare Mukankusi, Ellena Girma, Gloria Mosquera, Victoria Arredondo & Ernesto Espitia

Scientific Reports **14**, Article number: 15596 (2024) | Cite this article

1650 Accesses | **12** Altmetric | Metrics



Engaging Youth in Crop Protection Services Through Technology

Cost: ~$17/ha and takes 15 min/ha. But... How can we scale this to other countries? Develop capacities at scale? How can governments ease regulations?

Case studies on IPM innovations in legumes

Bundling of genetic and non-genetic complementary innovations

Sampling – Surveillance

- As part of resistance phenotyping activities, counting of pupae
  - **CGIARs**
  - **NARS**
- ***icipe*** - surveillance tools for monitoring infestation along the bean corridors

Resistance improvement

Standard Field Phenotyping

CGIAR
NARs

Mass rearing

CGIAR
NARS

Insect identification

- Samples of parasitoids and bean flies will be morphologically identified in the Insect Taxonomy Lab – icipe
- CGIAR – standardization of DNA extraction for molecular identification

Strategy of Bean Stem Maggot Management

Hotspots

Resistance sources

CGIARs
NARS

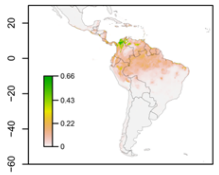
Standard Greenhouse Phenotyping

Insect model

Marker Assisted Selection

NARs
QTLs in literature reports

Risk analysis



- Risk map under changing climate is in progress by icipe

Management practices

- Tsekenedza, S. et al.-review submitted: Comparison of the effectiveness of bean fly (Ophiomya sp.) control methods in the common bean: A meta-analysis"
- Onyango, L. et al. –review in preparation about incidence, seasonality, cultural and biological control strategies, and trophic interactions, insect frass fertilizer
- ICIPE – Test of entomopathogens, plant stimulants, natural enemies, botanical extracts, insect frass fertilizer

Adoption of Biological Control Agents (BCAs)

BCAs in Action

- **Neem** biopesticides and cowpea pod powders can effectively kill **cowpea bruchid**, achieving up to 100% mortality in lab tests**.**
- **Fungal biopesticides** (*Metarhizium*, *Beauveria*) are used for field pests such as aphids and pod borers.

Progress:. **Harmonisation efforts** are ongoing to streamline biopesticide registration and approval across Africa through the AU.

Testing/scaling of biopesticides for beans in over 10 countries through the BRAINS project by Alliance Bioversity-CIAT and icipe

IPPC Webinar Series

Climate Change and Phytosanitary Issues

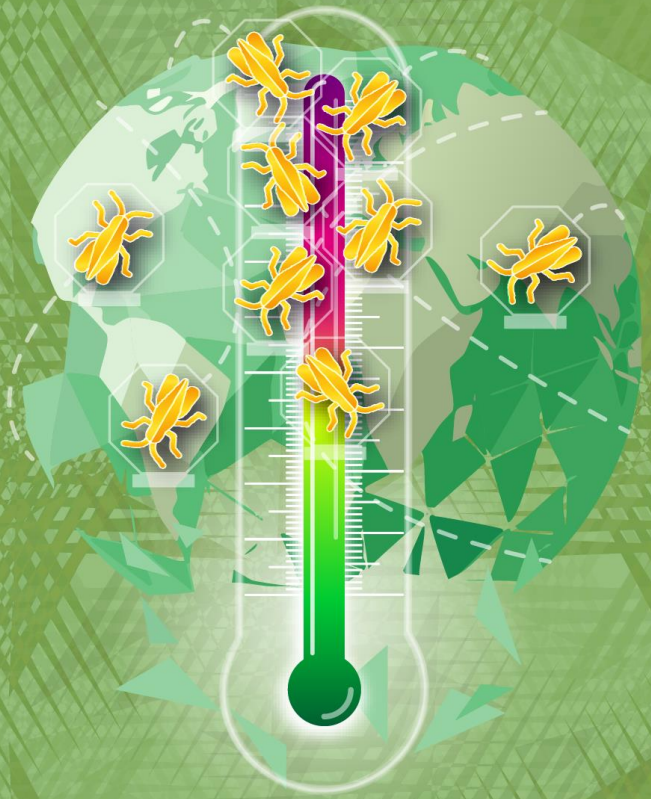
Climate Change and Phytosanitary Issues | 1–2 October 2025 | 14:00–16:00 CET

Large-scale application of conservation agriculture practices

IPPC Webinar Series

Climate Change and Phytosanitary Issues

1–2 October 2025 | 14:00–16:00 CET



Thank You

PABRA | The Pan-Africa Bean Research Alliance