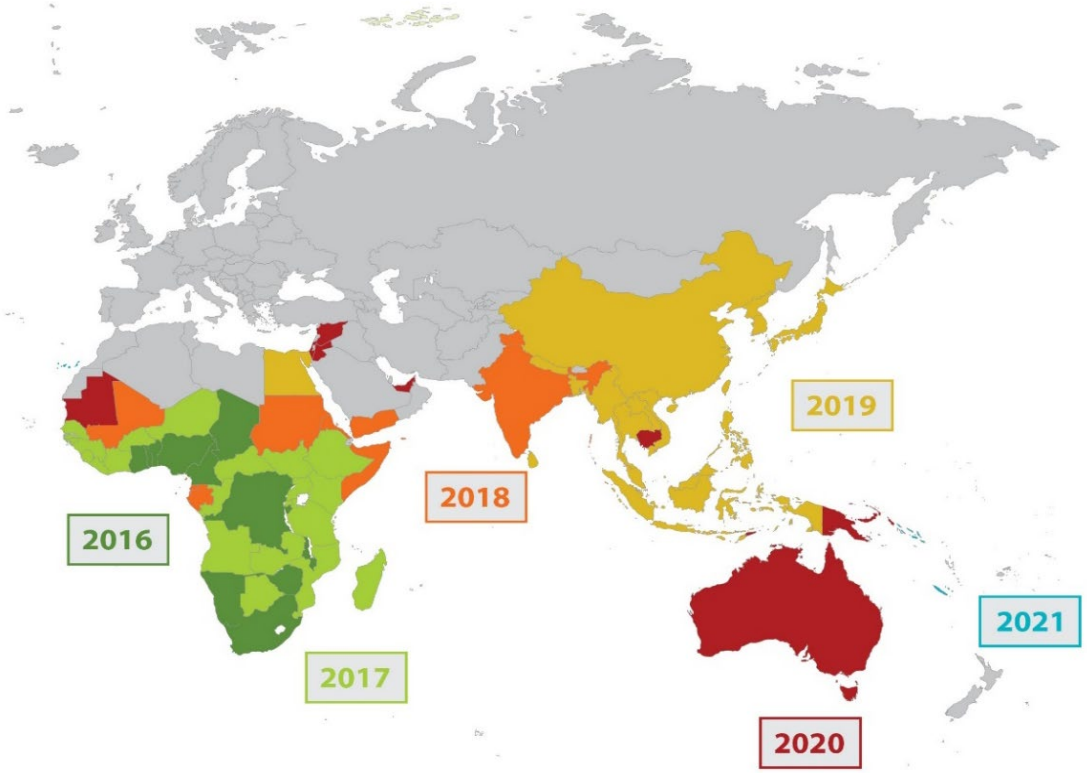
Sustainable Fall Armyworm Management

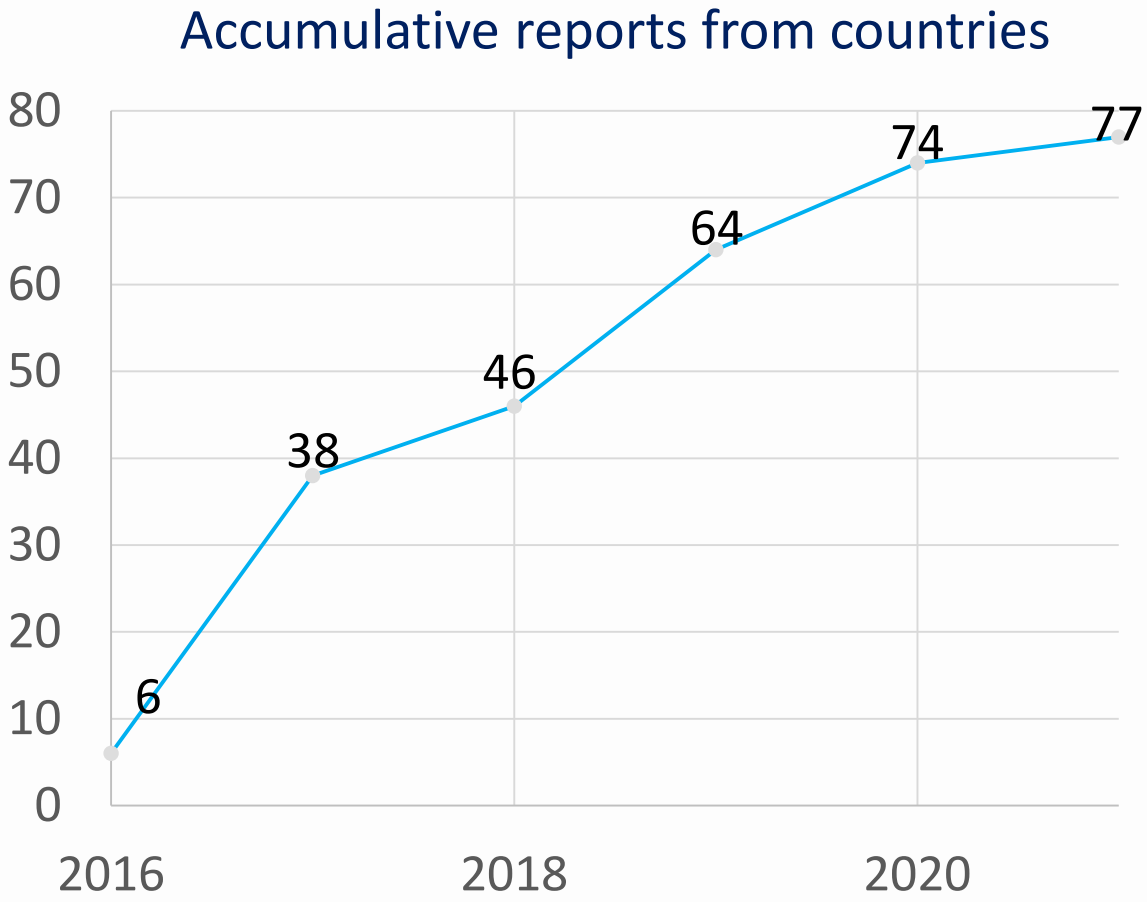
Buyung Hadi and Technical Committee Members

Global Action for Fall Armyworm Control Secretariat

FAO

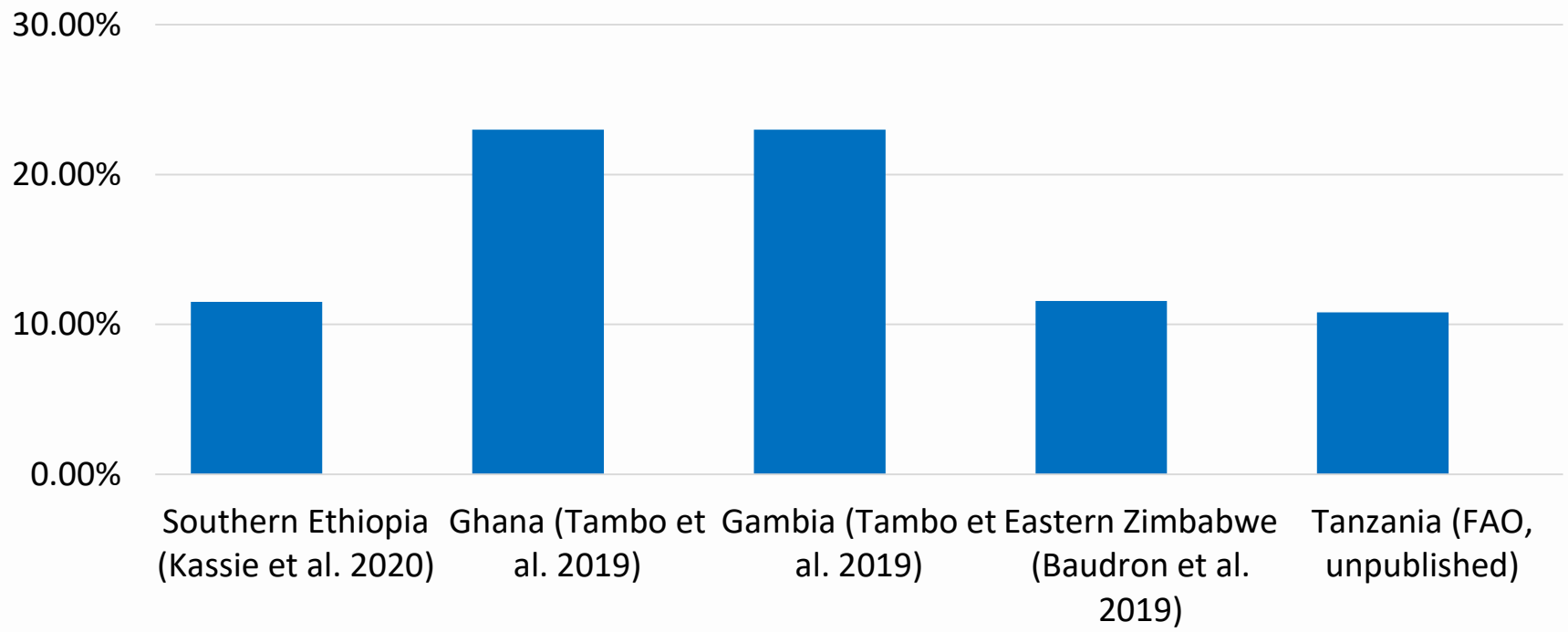
Challenges: fall armyworm as an invasive pest



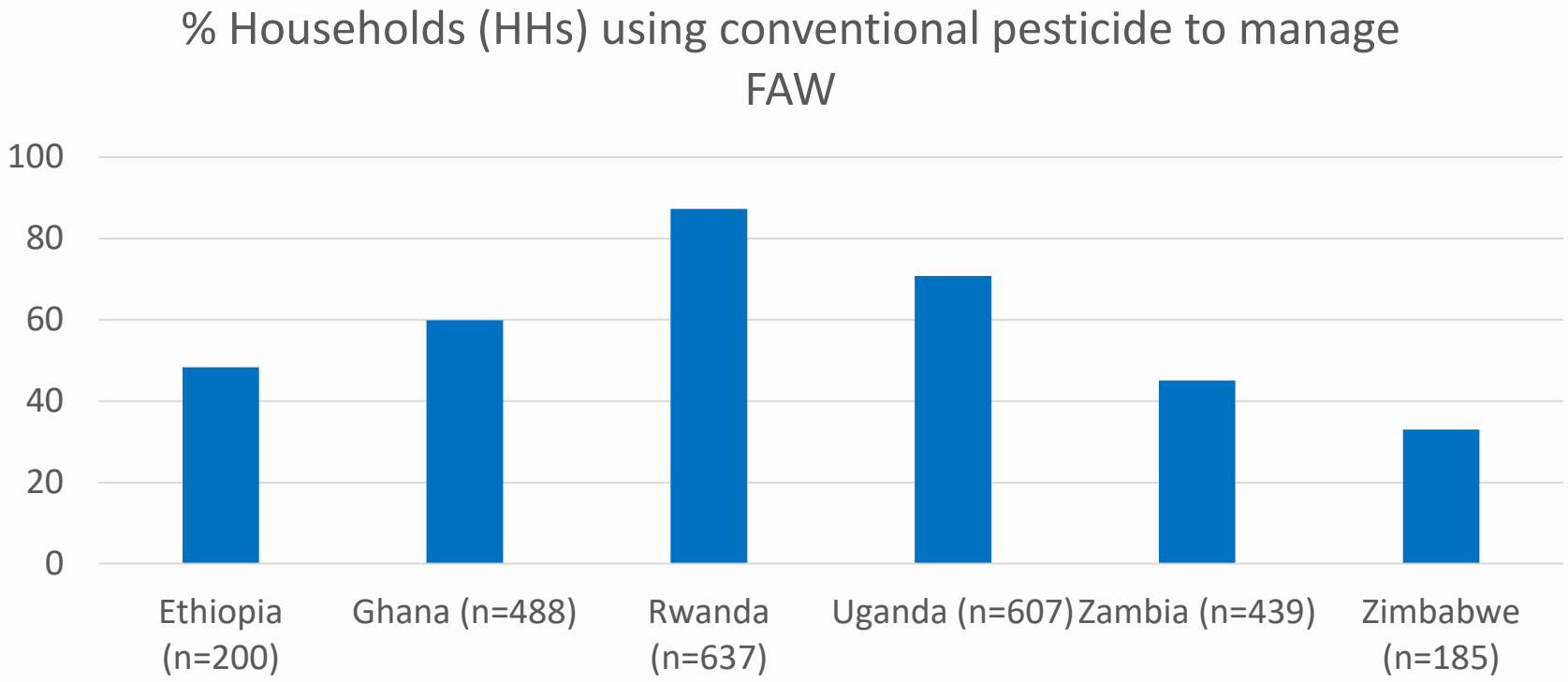


Challenges: Yield Losses

FAW was estimated to cause **USD 9.8 billion yield loss** in Africa (Eschen et al. 2021)



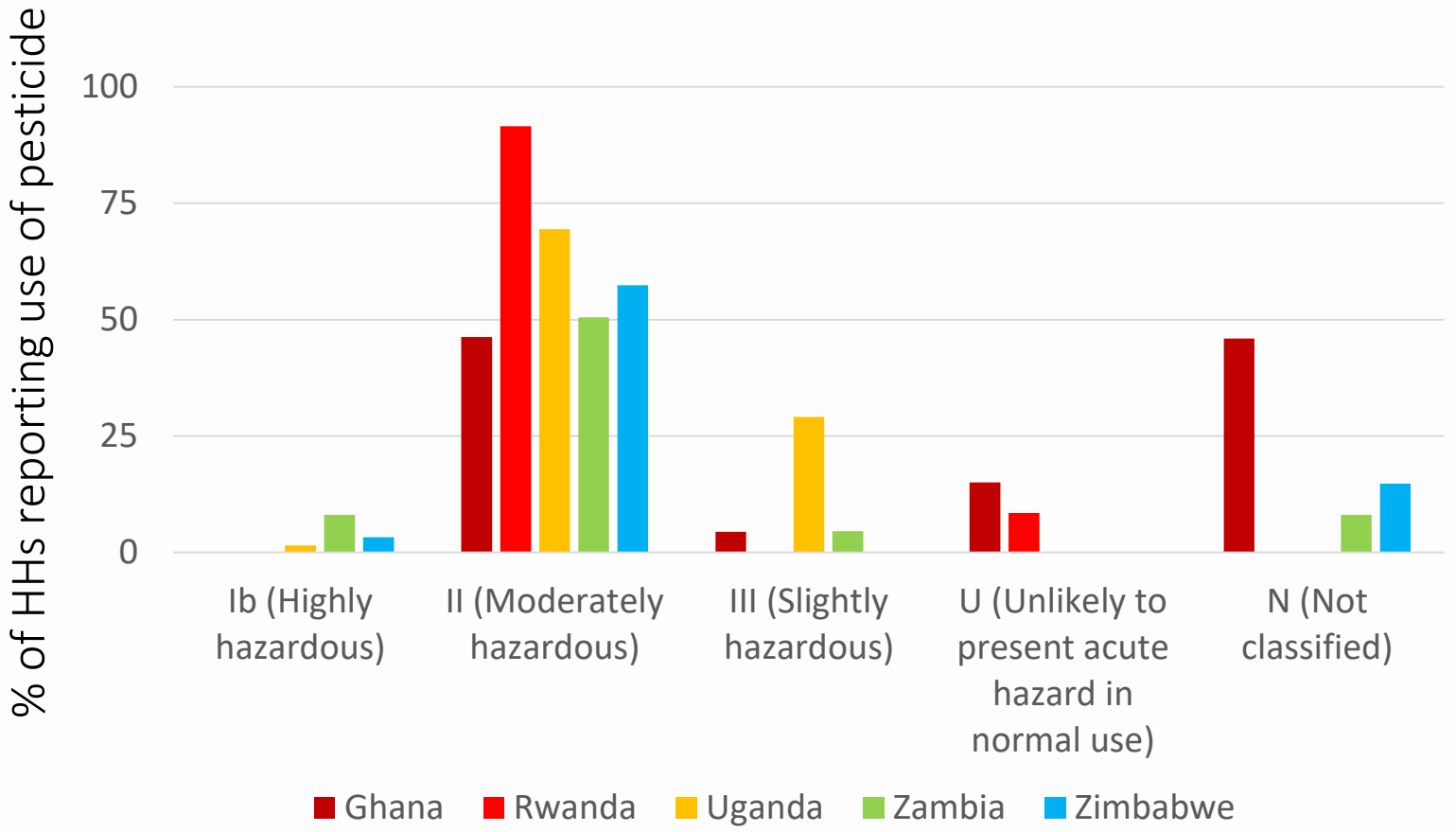
Challenges: Conventional Pesticides as the Predominant Management Techniques



Kumela et al. 2018

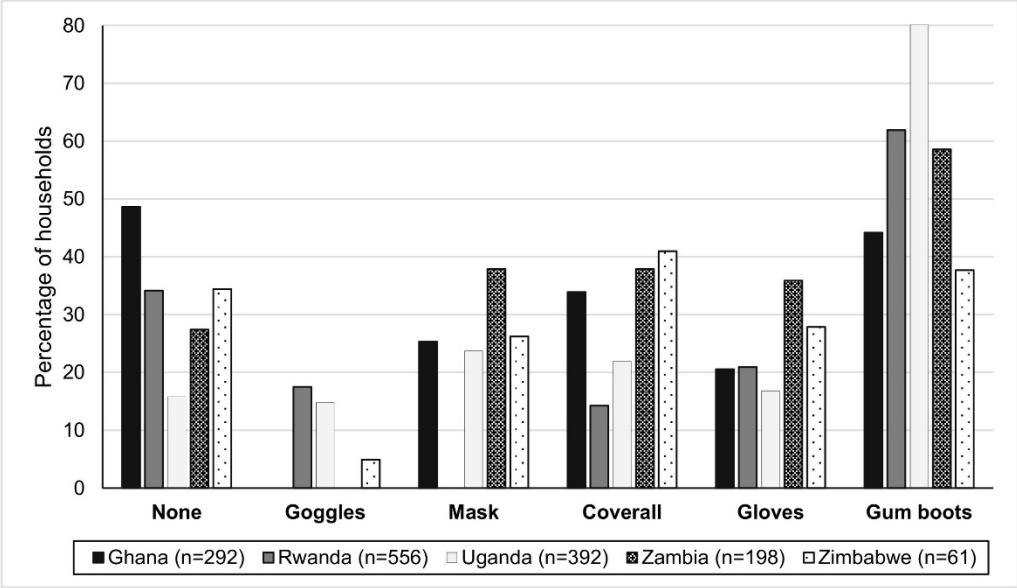
Tambo et al. 2020

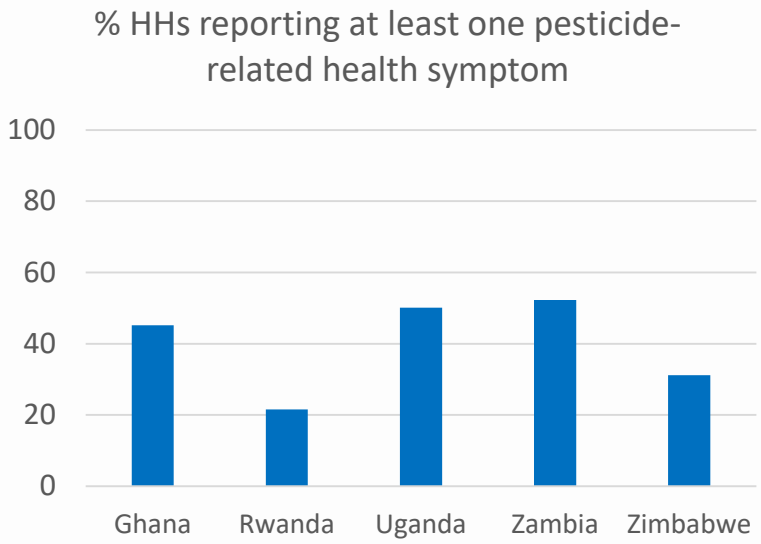
Challenges: Highly Hazardous pesticides



Tambo et al. 2020

Challenges: Weak Risk Reduction Practices



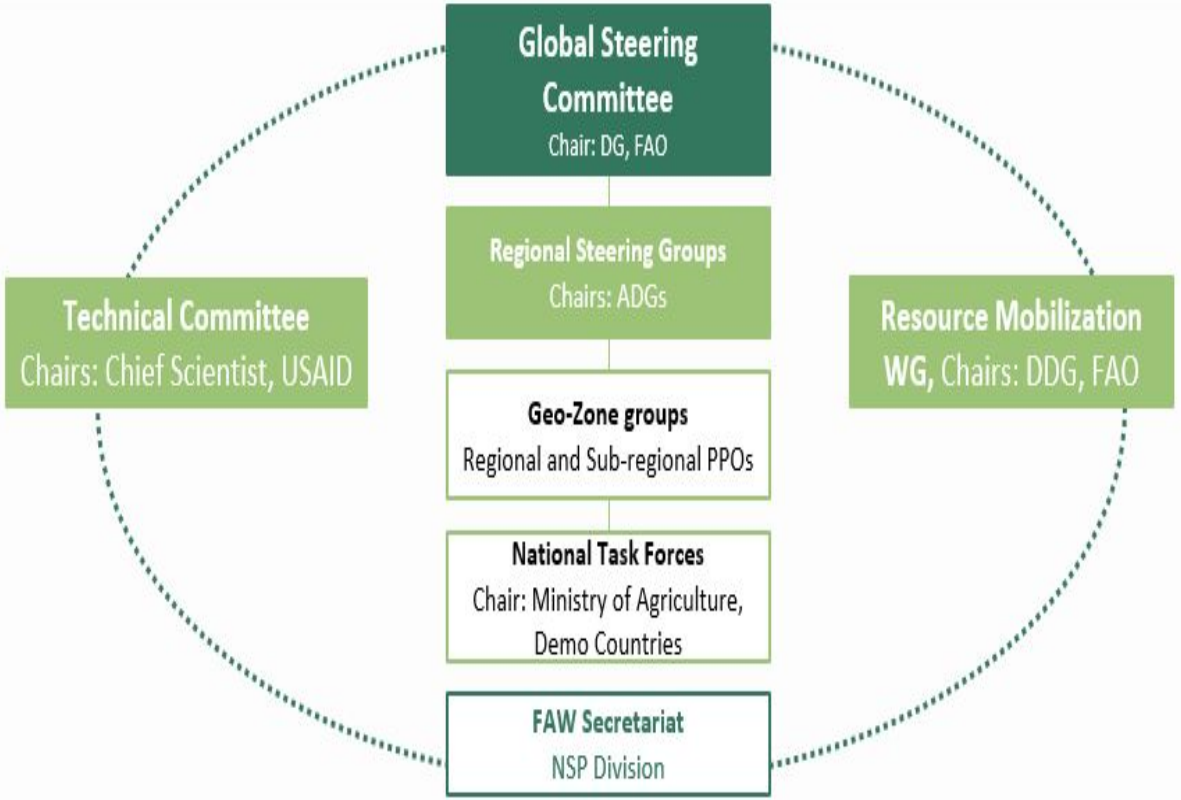


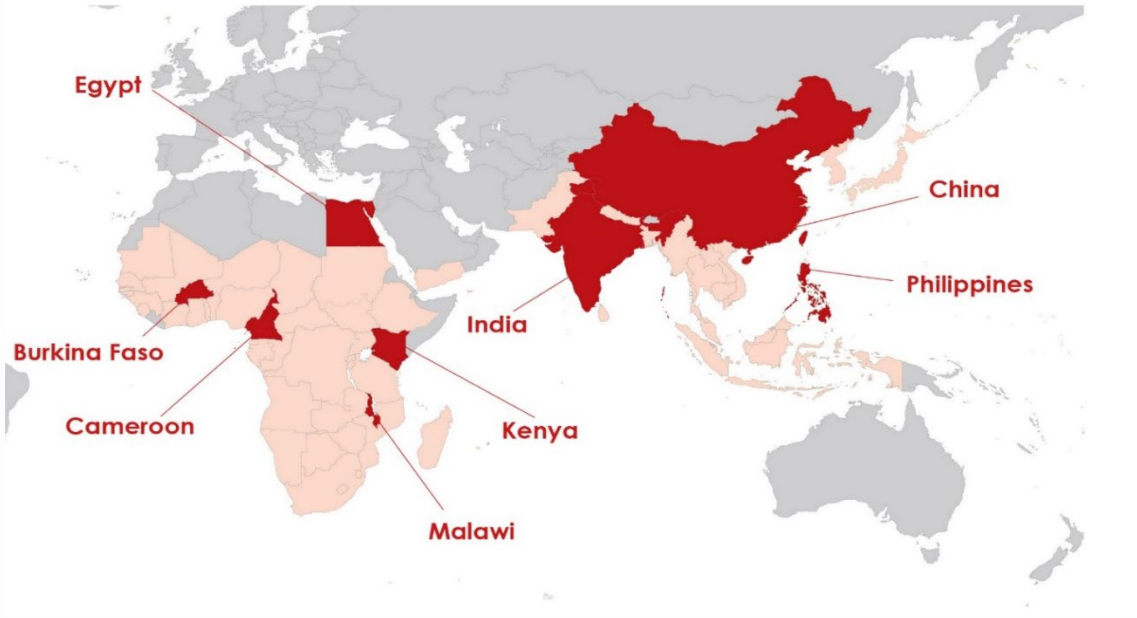
Tambo et al. 2020

The Solution: Global Action (GA) for FAW Control

- **Reduce Crop yield loss of 5-10%** by applying area-specific IPM strategies in target countries
- **Limit further spread to new areas** by applying phytosanitary measures
- **Conduct a global coordination**

Global Action for FAW Control





8 Demonstration countries, 54 Pilot countries

Progress in Technical Solutions: FAW IPM

Reduced risk pesticide

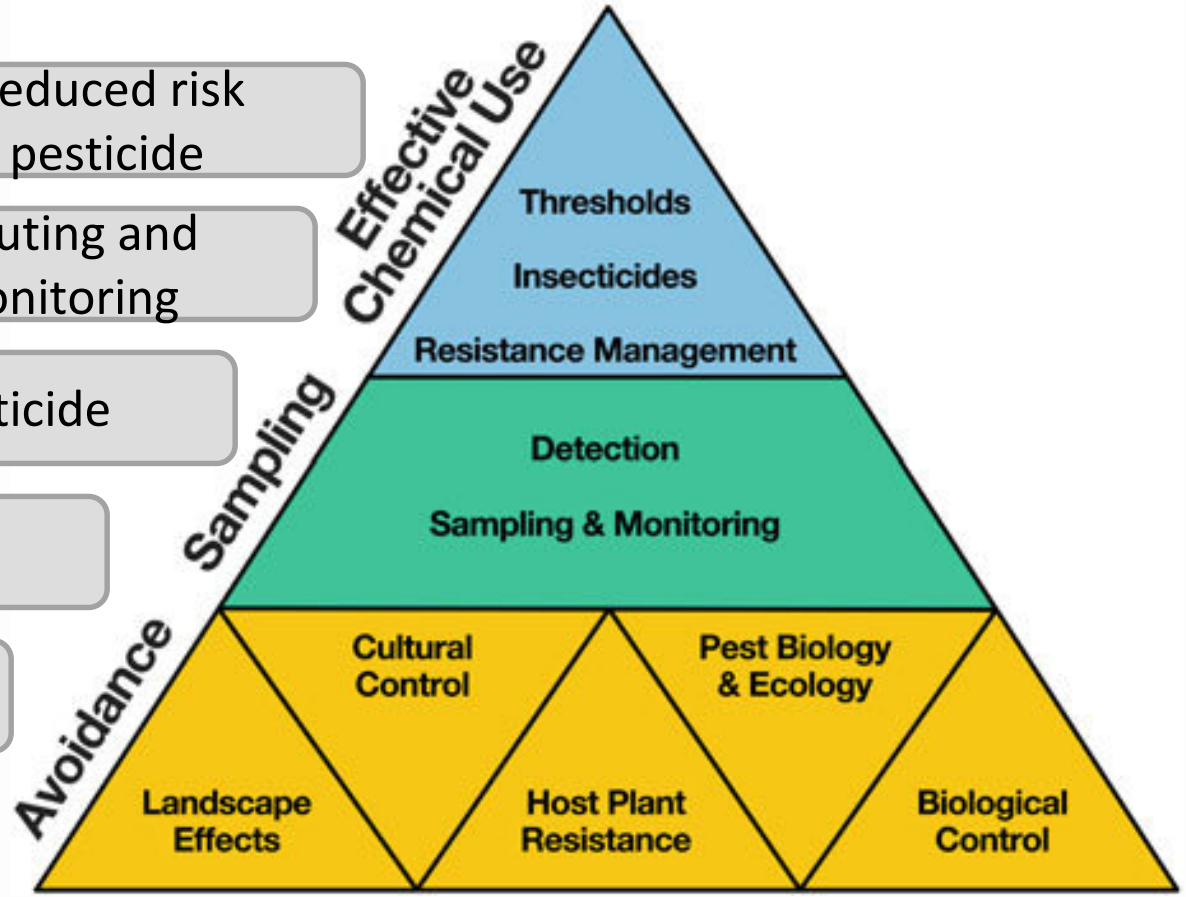
Scouting and monitoring

Biopesticide

Conservation biocontrol

GAP and diversification

Host plant resistance



https://www.fao.org/fall-armyworm/resources/en/

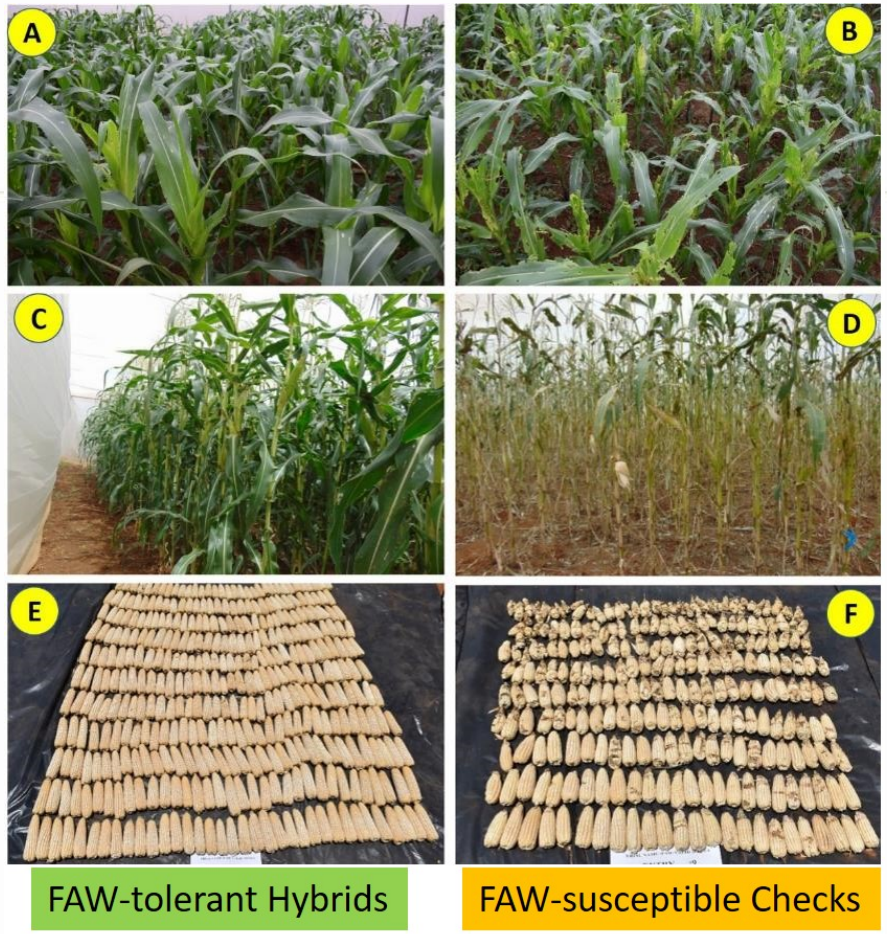
IPM Pyramid (Naranjo 2011)

Native Genetic Resistance to FAW

FAW-tolerant Maize Hybrids from CIMMYT

- More than **6000** CIMMYT maize germplasm entries screened so far against FAW under artificial infestation at Kiboko, Kenya, during 2017-2020.
- CIMMYT Maize Lines (CMLs) with native genetic resistance to FAW disseminated to partners across Africa and Asia.

Source: B.M. Prasanna (CIMMYT)



Three FAW-tolerant hybrids announced by CIMMYT for partners in Africa in Dec 2020; presently undergoing National Performance Trials (NPTs) in several countries.

Performance of FAW tolerant hybrids vis-à-vis commercial checks under "No-Choice Trials" at Kiboko (2020)

Name	Grain Yield (tons/ha)	Foliar Damage (1-9)	Ear damage (1-9)	Cob Exit hole (#)	Anthesis Date (d)	Bad Husk Cover (%)	Ear rot (%)	Ear aspect (1-9)	Plant aspect (1-9)	Plant stand (#)	Ears harvested (#)
FAWTH2001	7.1	3.5	2.1	1.2	70.4	4.1	5.2	2.6	3.4	464.4	370.3
FAWTH2002	7.9	4.2	2.2	1.0	70.4	3.8	4.6	2.8	3.4	462.7	359.9
FAWTH2003	8.6	3.6	2.2	1.8	70.4	3.8	5.2	2.6	3.8	454.6	362.0
DK777 (Commercial Check)	1.0	6.2	3.7	4.3	70.8	4.5	10.8	3.1	2.7	454.2	320.5
WE3106 (Commercial Check)	0.9	6.3	4.0	3.8	70.4	3.6	11.6	3.1	2.7	464.7	347.5
Grand Mean	**3.8**	**4.7**	**3.3**	**3.4**	**69.2**	**4.7**	**9.3**	**3.0**	**3.2**	**458.9**	**357.2**
Total No. of Entries	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Source: B.M. Prasanna (CIMMYT)

GAP and conservation biocontrol

Interventions	Effectiveness	Scalability	Strength of scientific evidences
Balanced fertilization using both organic and inorganic fertilizer	Moderate to high	High	High
Minimum tillage	Moderate to high	Moderate to high	High
Mulching	Moderate to high	Moderate to high	Moderate to high
Intercropping	Moderate to high	Low to high (Region dpdt)	High
Field margins for conservation biocontrol	High	Low to high (Region dpdt)	High
Food amendment for conservation biocontrol	Low to moderate	Low to moderate	Low
Mechanical control	Low to moderate	Low	Low

Biological control as a key component in FAW management

- Over 30 parasitoid and predator species in Africa and Asia (e.g. *Trichogramma pretiosum*, *Cotesia icipe*).
- Mass rearing and mass releases are being tested.
- Over 15 biopesticide options for FAW – Bt, SfMNPV, neem-based products showed promise.

New association of natural enemies of FAW in Africa

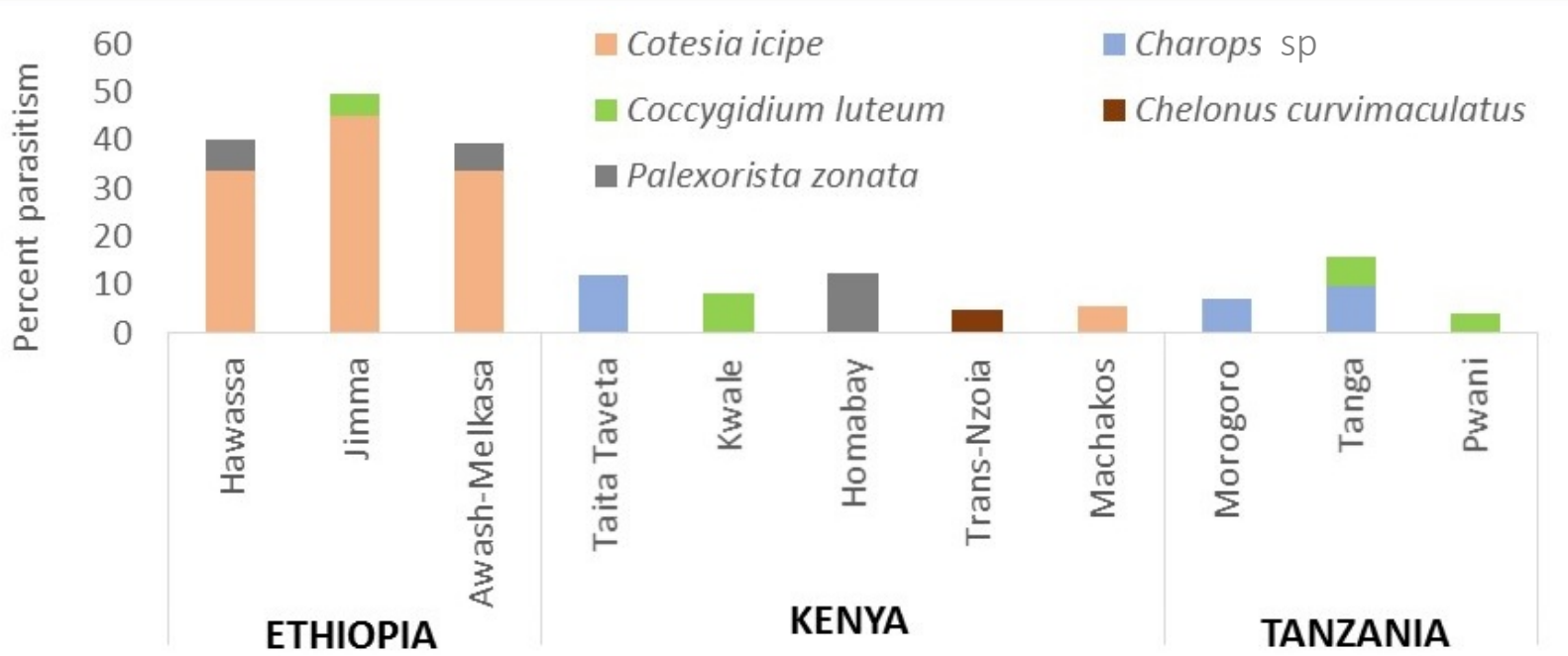
Received: 17 April 2018 | Accepted: 17 May 2018
DOI: 10.1111/jen.12534

SHORT COMMUNICATION

WILEY JOURNAL OF APPLIED ENTOMOLO

First report of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), natural enemies from Africa

Birhanu Sisay[1,2,3] | Josephine Simiyu[4] | Peter Malusi[4] | Paddy Likhayo[4] | Esayas Mendesil[1] | Nsami Elibariki[5] | Mulatu Wakgari[2] | Gashawbeza Ayalew[3] | Tadele Tefera[1]




Cotesia icipe


Chelonus curvimaculatus


Charops sp


Palexorista zonata


Coccygidium luteum

Source: Subramanian Sevgan, *icipe*

Potent natural enemies of FAW in Africa

Telenomus remus

Chelonus curvimaculatus

Trichogramma sp.

Up to 30% parasitism of eggs in the field

Charops sp

Coccygidium luteum

Cotesia icipe

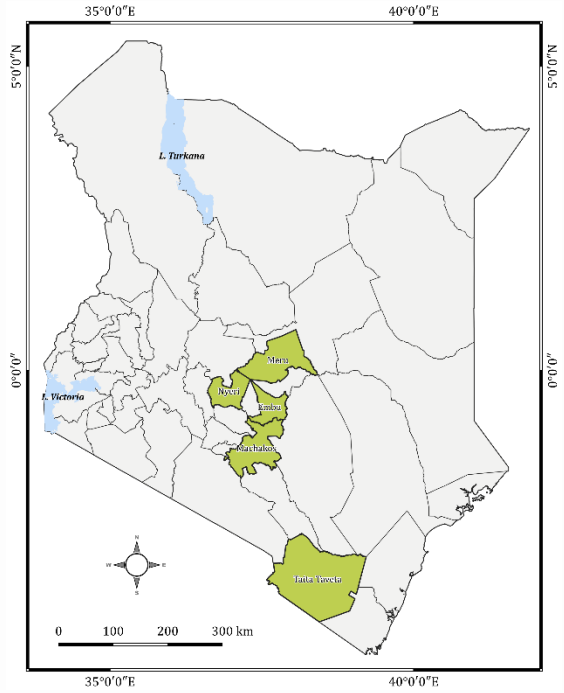
Palexorista zonata

Up to 45% parasitism of larvae in the field

Source: Subramanian Sevgan, *icipe*

Food and Agriculture Organization of the United Nations

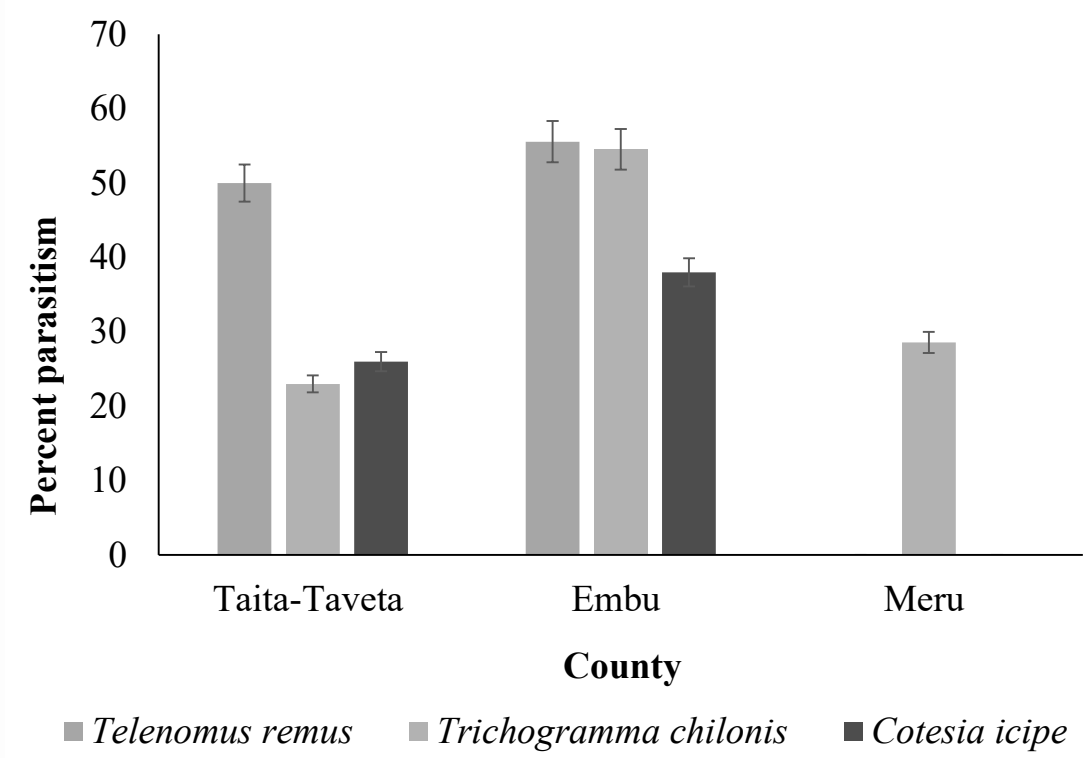
Mass releases of FAW parasitoids



Release of **Egg parasitoids**, *Telenomus remus* and *Trichogramma chilonis* in four counties

Release of larval parasitoid, *Cotesia icipe* in 5 counties

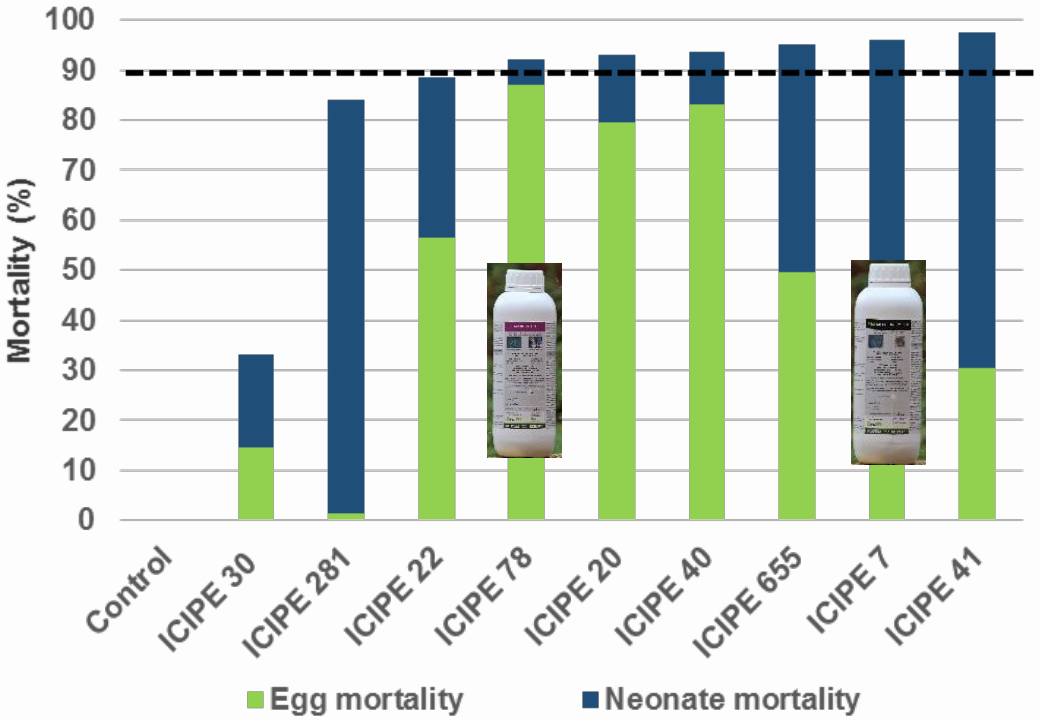
Post-release establishment of FAW parasitoids

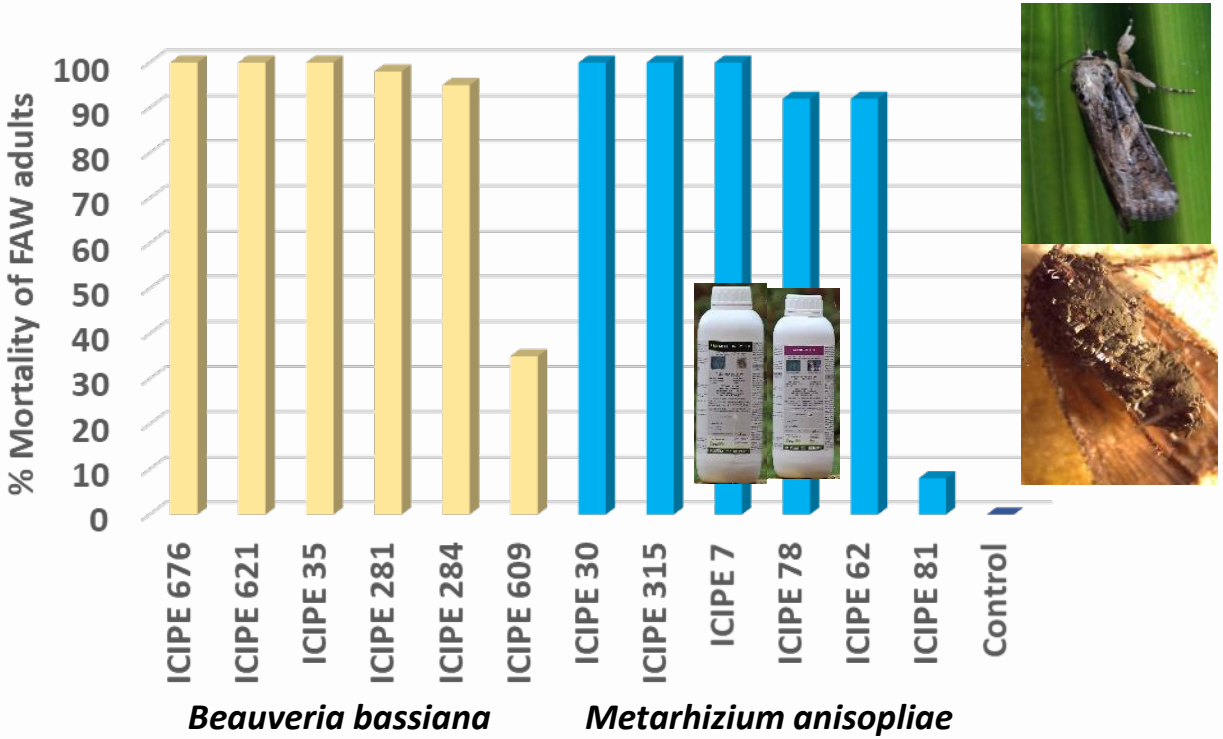


Pre-release percent parasitism ranged from 0 – 7% in the three counties

Source: Subramanian Sevgan, *icipe*

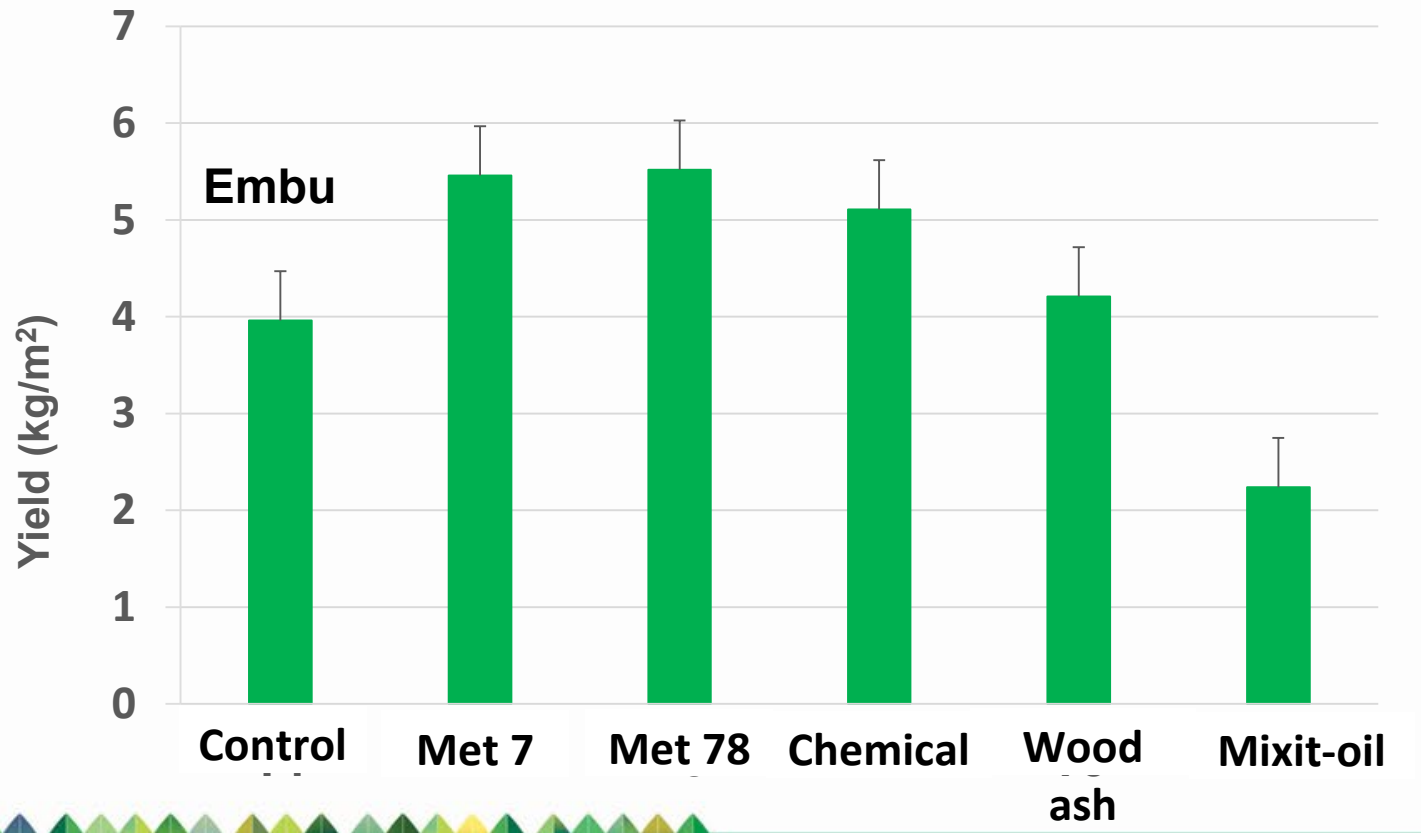
Efficacy of Entomopathogenic fungi against FAW





Source: Subramanian Sevgan, *icipe*

Impact of biopesticide application on yield of maize



Trials undertaken in three counties in Kenya: Embu, Kakamega, Homabay

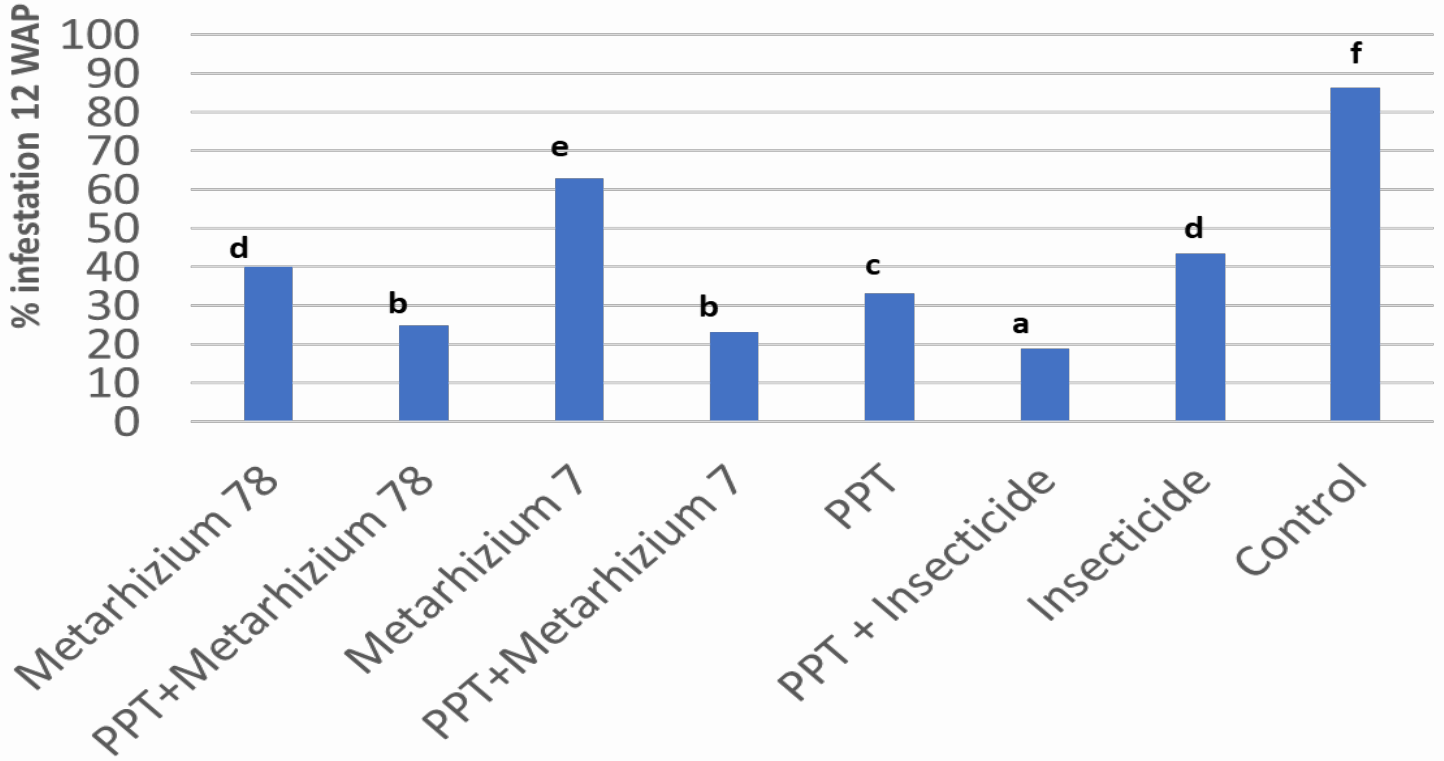
Registration trials for both Met 7 and Met 78 strains have been completed in Kenya, Tanzania and Uganda

realIPM

bioBest SUSTAINABLE CROP MANAGEMENT

Source: Subramanian Sevgan, *icipe*

Integrating Push-pull and biopesticides for FAW management in Tororo, Uganda



Source: Subramanian Sevgan, *icipe*

General challenges in mainstreaming biological control in FAW management

- Registration capacity for biopesticides
- Availability and accessibility of biopesticide options in local levels
- Capacities for local producers and local logistical chain
- Farmers' capacity for proper use of biopesticide

Minimum pesticide list for FAW control (Jepson et al. 2020)

	Efficacy unknown	<80% control	80-100% control
Highly hazardous pesticides	Phorate, monocrotophos, …	Carbofuran, carbosulfan, …	Beta-cyfluthrin, methomyl, …
High risk pesticides to health and environment requiring max PPE	Cartap hydrochloride	Abamectin, chlorpyrifos, …	Gamma cyhalothrin, lambda cyhalothrin, …
…			
Lower risk pesticides req single layer PPE, high env risk	--	--	Lufenuron, novaluron, spinetoram, spinosad, …
Lower risk pest for health and env	Pyriproxifen	Bt serovar kurstaki, *B. bassiana*, *M. anisopliae*	***A. indica*, Bt. serovar aizawai, SfNPV,** pyrethrum, chlorantraniliprole, flubendiamide, methoxyfenozide

IPM's Achilles' heels

Economic thresholds

ET is highly dependent on variety, plant and environmental health in general (e.g. co-stressors, levels of natural enemies)

ET is also highly dependent on local farm gate prices and costs of intervention

As such, ET should be highly localized (or at least calculated at regional/ national levels). These information are not always readily available, yet all pesticide application should be guided by it

Insecticide resistance management

Genetic mutation for organophosphate resistance from FAW populations collected in Asia and Africa (Guan et al. 2020)

Lab diagnosis showing development of resistance against some pyrethroids and organophosphate from FAW populations collected in Asia (Zhang et al. 2020)

Thank you