FACTSHEET

Department of Agricultural Research Services (DARS), Malawi, July 2020. www.dars.gov.mw Ministry of Agriculture & Food Security

Detain® *Metarhizium anisopliae -icipe 7* for Biological Control of Fall Armyworm *(Spodoptera frugiperda)* in Malawi

BACKGROUND

Maize production continues to face serious threats from Fall Armyworm (FAW), first reported during the 2016/2017 cropping season, FAW causes significant yield losses due to its rapid reproduction, nocturnal feeding habits, and increasing resistance to conventional pesticides.

While synthetic pesticides are commonly used, they raise serious concerns related to:

- Environmental pollution.
- Human health risks.
- High costs for smallholder farmers.
- Pest resistance and biodiversity loss.

To address these challenges, the Department of Agricultural Research Services (DARS), in collaboration with Total LandCare (TLC) and International Centre of Insects Physiology and Ecology (CIPE), evaluated and released **Detain®**, a biological control product for sustainable FAW management.

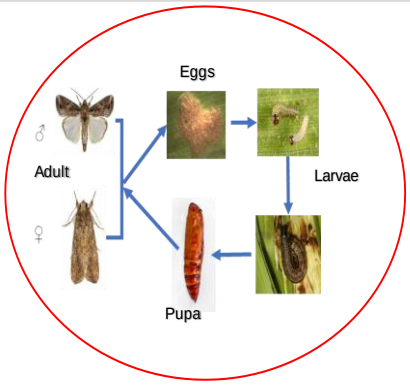

Fig 1.0 Life cycle of fall armyworm

Fig 2.0 Fall armyworm larvae destroying maize the plant

What is Detain®?

- Detain® is a **biopesticide**, a safe, natural product that uses a fungus (*Metarhizium anisopliae*, ICIPE 7) to control FAW.
- The fungus attacks FAW larvae only, its spores attach to the larva, penetrate the cuticle, multiply inside, and kill the pest within a week.
- Dead larvae become covered with greenish spores, which continue the infection cycle as shown in **Fig 3.0.**
- The product is traded as Detain. It is usually packed and marketed in 250 ml and 1.0 litres bottles as shown in **Figure 3.0.**

The results in Tables 1.0, 2.0 and 3.0 show that the use of Detain® significantly increased FAW mortality and reduced maize leaf damage consistently across the major agroecologies of Malawi.

- *Metarhizium anisoplae* optimum application rate of 400 ml and 500 ml was proven agronomically and economically ideal, **whose efficacy** is statistically similar to Chrolopyrifos, a synthetic pesticide.
- Dilute Detain at a rate of **2 ml per litre of water** as follows: 32 ml in a 16-litre knapsack sprayer or 40 ml in a 20-litre knapsack sprayer (*Equivalent to 400 ml of Detain and 200 litres of water per hectare).*

Benefits of Using Detain®

- Reduces **leaf and cob damage** caused by FAW.
- Increases **maize yields** with strong economic returns (Benefit–Cost Ratio 1.6–1.9).
- Does not cause pest resistance like synthetic chemicals
- Kills only the targeted FAW larvae and friendly to non-targeted insects.
- No toxicity to humans, animals, beneficial insects and the environment.
- Produce no-toxic residue to the environment.

Fig 3.0 Dead Fall armyworm larvae engulfed with the spores of *Metarhizium*

Table 2. Effects of *Metarhizium anisoplae* and inorganic pesticide treatments on the mean Leaf Damage at Chinguluwe EPA during winter, 2024 cropping season.

Experimental Treatments	Mean Leaf Damage			Treatment Effects
	T1	T2	T3	
Metarhizium anisoplae - 200*ml*/ha	3.75	4.75	4.75	4.417b
Metarhizium anisoplae - 300*ml*/ha	3.25	3.50	3.50	3.417c
Metarhizium anisoplae - 400*ml*/ha	3.00	3.75	3.75	3.500c
Metarhizium anisoplae - 500*ml*/ha	3.25	3.75	3.75	3.583c
Positive control - Chrolopyrifos	3.00	3.50	3.50	3.333c
Negative control - No treatment	5.25	6.75	7.25	6.417a
Time effects	3.58	4.43	4.417	
$LSD_{(0.05)}$ Treatments (T) 0.4654***				
$LSD_{(0.05)}$ Time (TM) 0.329ns				
$LSD_{(0.05)}$ TxTM 0.306ns				
CV% 13.8				

Table 3. Effects of *Metarhizium anisoplae* and inorganic pesticide treatments on percent mean **mortality of FAW** at Champhira EPA during winter, 2024 cropping season.

Experimental Treatments	Percent Mean Mortality			Treatment Effects
	T1	T2	T3	
Metarhizium anisoplae - 200*ml*/ha	33.2	34.5	47.5	38.4b
Metarhizium anisoplae - 300*ml*/ha	44.9	34.6	61.5	47.0b
Metarhizium anisoplae - 400*ml*/ha	58.7	73.1	72.0	67.9a
Metarhizium anisoplae - 500*ml*/ha	61.1	76.9	56.0	64.7a
Positive control - Chrolopyrifos	60.1	83.6	54.4	66.0a
Negative control - No treatment	16.5	10.0	12.7	13.1c
Time effects	45.7a	52.1a	13.1b	
$LSD_{(0.05)}$ Treatments (T) 9.20***				
$LSD_{(0.05)}$ Time (TM) 6.50***				
$LSD_{(0.05)}$ TxTM 15.93ns				
CV% 27.7				

*Values with the same letter under the same column are not significantly different at P<0.05; *=P<0.05; **=P<0.01; ***=P<0.001. ns= not significant P>0.05; T1 = Leaf Development (V1); T2= Stem Elongation (V7); T3= Tasseling stages (VT)*

SAFETY AND PRECAUTIONS

- Wear protective clothing during mixing and spraying.
- **Do not** mix Detain® with any synthetic chemicals; it should be applied on its own.
- Wash the sprayer **thoroughly** with clean water before using Detain® to remove any residuals from previous chemical applications. Please, only use water from boreholes and wells.
- Be aware of the sprayer's history - whether it was previously used synthetic pesticides or herbicides - to avoid contamination.
- Wash hands and equipment after use.
- There is no pre-harvest interval for Detain®; it can be safely applied up to the day of harvest.

WHEN TO APPLY

- Scout fields early and regularly to detect FAW larvae and caterpillar numbers.
- Apply Detain® only when FAW infestation is observed.
- Most effective when larval populations are low and caterpillars are small at 1st or 2nd instar stages, as they feed on open leaf surfaces accessible to sprays.
- First application: As soon as FAW is detected, usually when maize is 2 weeks old after germination.
- Second application: 2 weeks later, but application frequency depends on pest infestation levels.

APPLICATION GUIDELINES

Timing: Apply in the evening or early morning when larvae are **most active** and to protect the fungal spores from full sunlight.
Avoid: Full spraying during suny and rainy weather conditions; **do not** apply when **no** FAW infestation is present.
Target: Spray directly into the maize whorl (funnel), where FAW larvae **feed** and **hide**.

HOW TO APPLY BIOPESTICIDE IN THE FIELD?

- **Remember:** biopoesticide contain living organisms as active ingredients, therefore before applying biopesticide, conduct an **early scouting** to detect the presence of caterpillars and larvae numbers.
- When the larvae numbers are low, it will result in the most effective control.
- Apply when eggs are due to hatch or when caterpillars are small (1st and 2nd instars). These are the most susceptible stages because the caterpillars feed on open leaf surfaces that are accessible to sprays.
- When applying make sure, you wear appropriate personal protective clothing (gloves, apron, respirator, hat and boots) as shown in **Figure 5**.

Fig 3.0 Untreated Maize heavily infested with fall armyworm.

Fig 4.0 Clean maize treated with Detain assisted by monitoring tools *(Pheromone trap)*.

Fig 5.0 Personal protective materials