AGROSOLUTIONS LTD.

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Nature of Company/Business:

- Private company
- Imports & distribution of own branded pesticide products (crops only)
- In operation for the last 11 years – February, 2017
- Operations in all important agricultural areas (crops) except:
  - Coffee
  - Cotton
  - Sugarcane
  - Tea
- Has 22 registered products in the market

Products:

AGROMAX 720WP
AZOXY TOP 325SC
BOTRAN 500SC
FUNGINEX 400SC
GALILEO 125EW
PROMIDONE 500SC
PROTEKTOR 722SL
SENATOR 800WP
STAMINA 500SC
SYNERGY 700WG

ALPHAKILL 100EC
DYNOMITE 150EC
EVIK 600SP
HEXYGON 100EC
MERIT 150SC
VOLTAGE 5EC

COBRA 760WDG
MORAN 75EW
WEEDMASTER 500SC

DRENCH
FORSCROP Ca/Mg
POWER GRO

Control of Fall Armyworm in Maize

using

MERIT 150SC

Coverage:

1) Introduction
2) Nature of Fall armyworm pest
3) Fall armyworm hosts plants
4) Importance of Fall armyworm in maize
5) Fall armyworm lifecycle in relation to maize crop damage
6) Manifestation of crop damage and significance to maize crop yield
7) Critical maize growth stages in relation to Fall armyworm infestation
8) Fall armyworm identification among other Lepidoptera pest
9) Fall armyworm monitoring
10) Action plan on Fall armyworm upon detection
11) Use of Merit 150SC for the control of Fall armyworm in maize
12) Summary
13) Open Discussion – “Farmer awareness of MERIT 150SC for control of Fall armyworm in maize”

FALL ARMYWORM

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Scientific name: *Spodoptera frugiperda*

Native of Central America & Southern USA

Close relatives: African armyworm
Maize stalk borer
Cutworms

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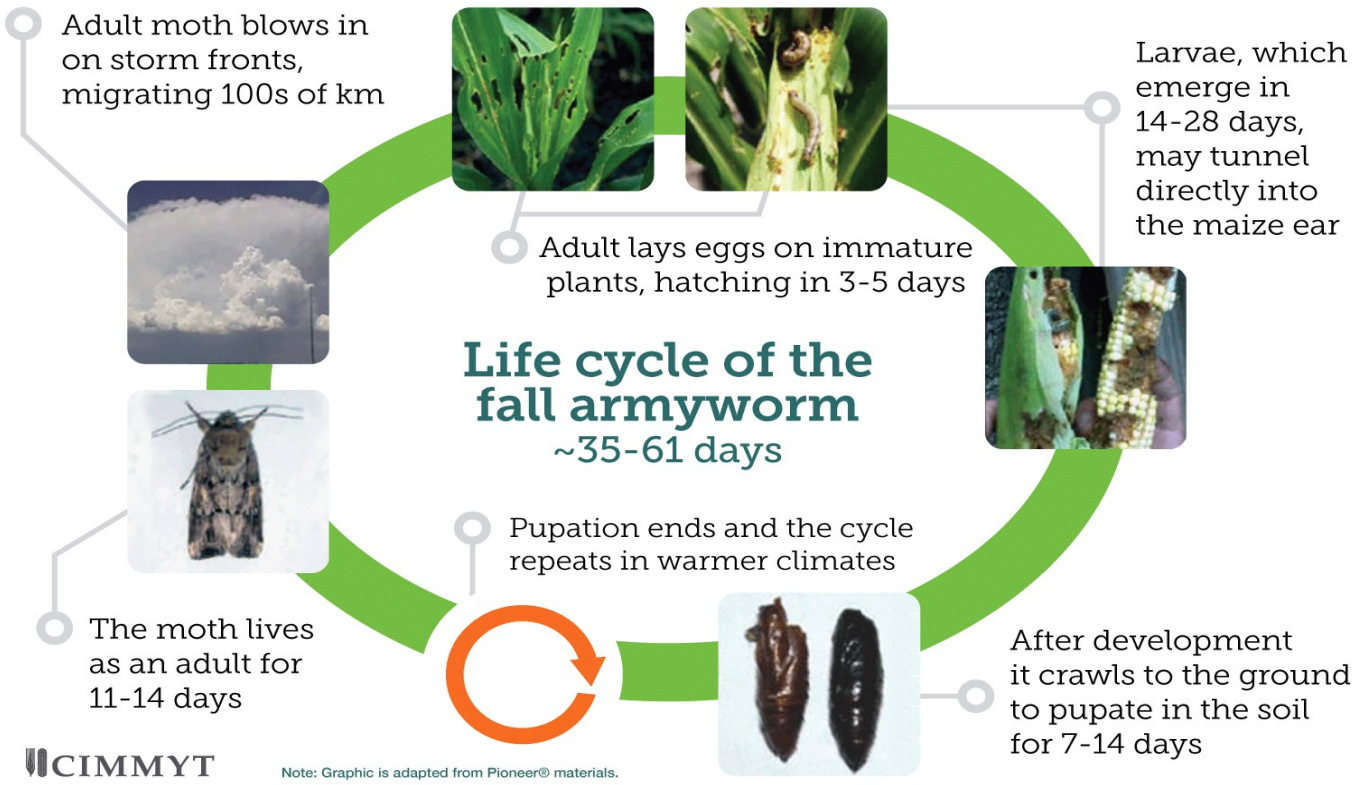
FALL ARMYWORM LIFECYCLE



FALL ARMYWORM PREFERED CROPS

Prefer monocot crops (grass type):

—**Maize (most preferred)**
—Sorghum
—Millets
—Rice
—Wheat
—Sugarcane
—Pastures
—Vegetables

IMPORTANCE OF FALL ARMYWORM

—Most important maize pest worldwide.

—Newly introduced pest in Africa.

—Has multiple plant hosts (> 80 plants).

—Ability of fast migration to new areas (regions):

- by flying/carried by wind;
- can fly over 100 Km overnight.

—Favourable tropical climate round the year.

—Fast reproduction:

—Resistance to insecticides:

—High economic damage on crops:

- May cause up to 25 – 53% yield loss;
- 55 – 100% of infestation on plants may cause 15 – 75% yield loss;
- 5 larva/plant may cause 6% yield loss;
- 0.2 – 0.8 larva/plant in late vegetative stage reduces yield by 5 – 20%.

FACTS OF FALL ARMYWORM IN MAIZE

- Female moth lays 100 – 200 eggs at a time.
- Eggs are laid on the underside of the leave near the base of the plant, close to the junction of the leaf and the stem.
- Female can lay 1,000 – 2,000 eggs in a life time of 14 days.
  - Most eggs are laid by young adults in the first 4 – 5 days.
- Eggs hatch into small larva in 2 – 3 days.

Egg mass

FACTS OF FALL ARMYWORM IN MAIZE

LARVA is the destructive stage that lasts for 14 days.

There 6 larva stages:

1) 1st instar – 3.3 day
2) 2nd instar – 1.7 day
3) 3rd instar – 1.5 day
4) 4th instar – 1.5 day
5) 5th instar – 2.0 day
6) 6th instar – 3.7 day

Total – 13.7 days

Hatching eggs

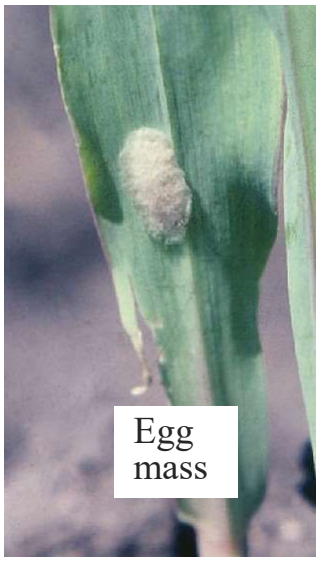
Mature larva

FACTS OF FALL ARMYWORM IN MAIZE

- The first 3 larva instars are small and not easily detected.
- They feed on the underside of the leaf causing “windowpane’ like damage.
- Young larva can spin silk threads which catch wind and transport them to new plants.
- Larva prefers feeding in leaf funnel in young plants and leaves around the cob silks in older plants.
- For the plant with developing cob, the larva eats its way through the protective leaf bracts into the side of the cob where it begins feeding on developing seeds.
- Older larva normally feed inside the leaf funnel or developing cob.
- Feeding is more active during the night, in the morning and evening but not during hot day.
- During hot day the larva hide underside the leaf or in the leaf funnel.
- Mature bigger larval feed 50 times more than the small ones and cause more crop damage.

FALL ARMYWORM INJURY SIGNS IN MAIZE

Early stage Larva Feeding



FALL ARMYWORM INJURY SIGNS IN MAIZE

Late stage Larva Feeding

Elongated, ragged holes, leaf cut in half, injuries in the leaf funnel, developing tassel, seeds and sawdust-like frass on leaves and funnel

Why do we have overnight crop destruction by Fall armyworm?

— Young larva don't eat much and therefore cause less destruction.

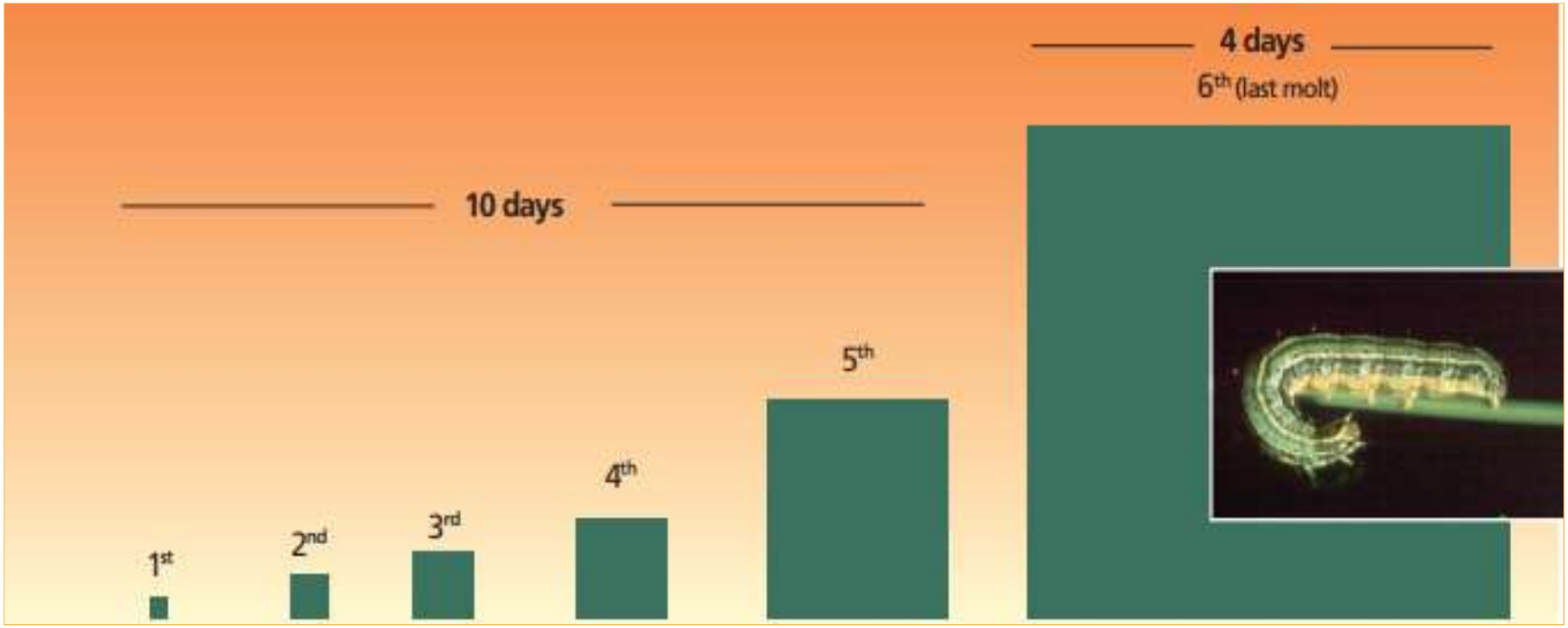
— Almost all the damage is caused by old larva, which in 4 days of feeding, eat more than all other stages put together.

— Infestation may have been there but not detected in time because of the small size young larva and ability to hide during the day.

— Larger larva sometimes quickly invades an uninfested area in search of food once an adjacent crop or pasture has been exhausted.

— Large larva also frequently disappears almost as suddenly as they appeared, either burrowing into the soil to pupate or in migration.

RELATIVE FOOD EATEN BY FALL ARMYWORM LARVA STAGES



Under warm weather condition, a larva feeds for about 14 days.
Most of the food is consumed in the last four days by 6th instar larva.

Why does Fall armyworm damage the crop in waves of 3 – 4 week?

— Moth activity and egg laying peak periodically although there is overlap between generations.

The crop should therefore be monitored closely throughout the growing , especially in late vegetative stage before and during tasselling and cob development.

Which crop is at highest risk of Fall armyworm damage?

— Late-maturing crop variety;

—Late-planted crop at late vegetative stage (before tasselling)

OTHER DEVELOPMENT STAGES OF FALL ARMYWORM

PUPA STAGE

The larva burrows in the soil as pupa for 8 – 9 days then emerges as an adult.

Pupa burrow 2 – 8 cm in soil or under the debris if soil is hard.

ADULT MOTH

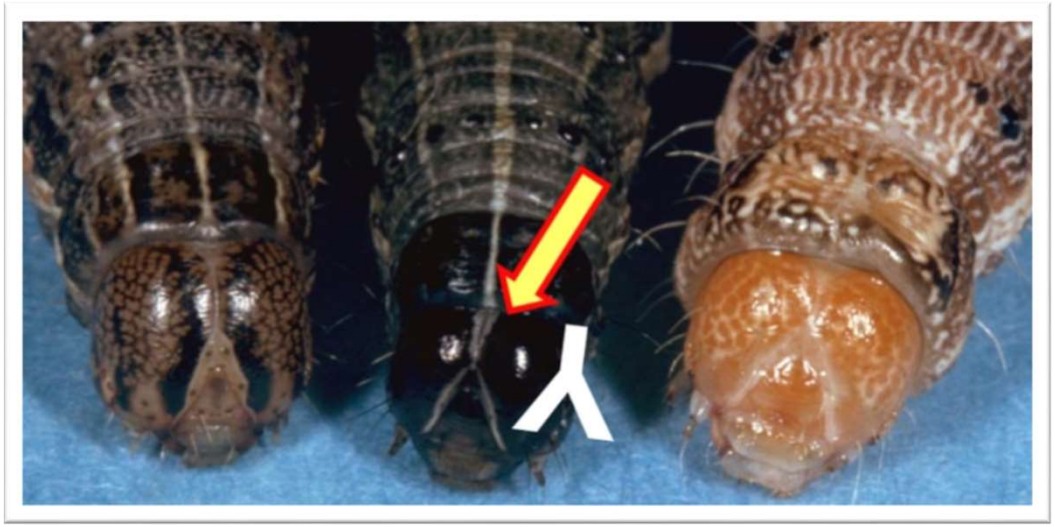
The adult is a moth that is active during the night – not easily detected.

Adult lives for 14 days.

The lifecycle of Fall armyworm is 35 – 36 days

It is possible to have three life cycles affecting maize in a season

IDENTIFICATION OF FALL ARMYWORM



Distinct white inverted **"Y"** on the front of dark head.

Young lava not distinguished easily

Distinct **dark spots (tubercles)** on the back near the tail.

SUMMARY OF FALL ARMYWORM ON MAIZE

- Feeding damages on leaves.
- Defoliation reduces photosynthetic area thereby reducing maize yield.
- Deep feeding in the funnel may destroy developing tassel/cob.
- Larva feeding of the young developing grains reduces grain quality and yield.

MONITORING OF FALL ARMYWORM

(1) Trapping adults Moth:

- Ministry of Agriculture and large farms – using pheromone traps.

(2) Scouting:

- Physical check of the crop twice/week is a must to every farmer.
- Aims at detecting fall armyworm before damage is caused.
- Inspect the crop and nearby grasses in detail.
- Look for cream/grey egg masses or young larva on the undersides of leaves and the funnel.
- Look for patches of small "windowpane" holes to large ragged and elongated holes in the emerging leaves.

Remember!

The pest is Fall armyworm if:

— It has a **dark head** with an upside down pale Y-shaped marking.

— It has four dark spots on the 2nd last body segment.

IMMEDIATE ACTIONS AFER FALL ARMYWORM DETECTION

(1)Small scale with large family:

- do hand picking of larva.

(2) **Pesticide Spray Treatment:**

- Use of effective insecticides on detecting Fall armyworm in early stages of crop damage presence of egg masses, small larva or windowing of leaves stage.
- Not all insecticides are effective.
- Pyrethroids and organophosphate are not effective.
- Continue monitoring after treatment and consider further treatment if more young larvae appear. Continue until plants become too large to monitor/treat.

Agrosolutions Ltd.

INSECTICIDE FOR FALL ARMYWORM

MERIT 150SC

Indoxacarb 150 g/L Suspension Concentrate

TARGET PEST

Specialist Insecticide for control of Lepidoptera sp. (caterpillars):

1) FALL ARMY WORM & ARMYWORM in maize, sorghum, wheat, etc

2) TUTA ABSOLUTA in tomatoes

3) DIAMOND BACK MOTH in cabbages and canola

REDUCED RISK PESTICIDE

1) Low impact on human health,
2) Low toxicity to non target organisms (birds, fish and plants),
3) Low potential for groundwater contamination,
4) Lower use rates,
5) Low pest-resistance potential and
6) Compatibility with Integrated Pest Management (IPM) programs.

MODE OF ACTION

Block sodium channels, causing nervous system shutdown and paralysis.

OTHER STRONG COMPETING INSECTICIDES FOR FLL ARMYWORM:

a) Chlorantraniliprole 200 g/L SC: **CORAGEN 200SC**

b) Chlorantraniliprole 45 g/L + **Abamectin 18 g/L SC: VOLIAM TARGO 63SC**

c) Flubendiamide 480 g/L SC: **BELT 480SC**

The two products have similar mode of action but different from MERIT 150SC.

They activate muscle ryanodine receptors, leading to contraction and paralysis.

KEY BIOLOGICAL FEATURES

1) Broad-spectrum Lepidoptera pests.
2) Work by ingestion and contact activity.
3) Causes quick irreversible feeding inhibition.
4) Exhibits residual control of 10 – 14 days.
5) Used for control of larva stages but has activity on eggs (ovicidal activity) and adults .
6) Novel mode of action.
7) Favorable environmental and ecological profile.
8) Has rain fastness after spray has dried.
9) Has positive temperature correlation for pest control and residual activity
   - — works best at high temperatures.

HOW IT WORKS

- The primary route of entry is through ingestion of treated foliage.
- Pests exposed stop feeding within 0 to 4 hours.
- Causes death in 48 - 72 hours.
- Insects exposed exhibit the following symptoms:
  - ✓Stop feeding that is irreversible
  - ✓Incoordination
  - ✓paralysis
- Has ovicidal activity to all lepidoptera species .

MERIT 150SC

Recommendation for Control of Fall Armyworm

APPLICATION TIMING AND TECHNIQUE

- ✓ Spray treatments **must start early** on actively growing crop when fall army worm egg masses, small "windowpane" holes and/or small caterpillars are noticed in the crop before heavy damage is caused.
- ✓ Late spray treatments when the larva has moved **deep in the leaf funnel** or **developing cob** will not give the desired control.
- ✓ Make spray treatments **early in the morning** or **late in the evening** when caterpillars are actively feeding.
- ✓ Ensure there is thorough coverage of leaf surface and the funnel by using a spray volume of:
  - **250 L/Ha or**
  - **5 knapsack sprayer/Acre**
- ✓ If there is re-infestation, repeat spray treatments at 14 days interval.
- ✓ It maybe necessary to make at **least 3 spray treatments** starting at the onset of infestation on young crop to tasselling stage.

MERIT 150SC APPLICATION RATE

ALL CROPS	APPLICATION RATE
Maize, Sorghum, Millets, Rice, Sugarcane, Wheat, Vegetables, Pasture	300 ml/Ha *(120 ml/Acre)* 25 - 30 ml/20 L

Important Notes

- ✓ Lower rate than recommended may take longer for the pest to stop feeding and eventual death.
- ✓ High temperatures increases the speed of kill.
- ✓ The insecticide kill should be evaluated 72 after treatment.
- ✓ Within less than 24 hours of treatment, the larva remains still or sluggish but may not be dead.

PREPARATION OF SPRAY MIXTURE

- ✓ Mix the content to uniformity before opening.
- ✓ Half fill the sprayer with water.
- ✓ Add the required amount of MERIT 150SC.
- ✓ Fill the sprayer with water to the level and stir to uniformity.
- ✓ Do not let the prepared spray solution stay overnight.

MAIN COMPETING INSECTICIDES FOR FALL ARMYWORM

PRODUCT	ACTIVE INGREDIENT	APPLICATION RATE	
BELT 480SC	FLUBENDIAMIDE	100 ml/Ha	10 ml/20 L
CORAGEN 200SC	CHLORANITRANILIPROLE	150 ml/Ha	15 ml/20 L
MERIT 150SC	INDOXACARB	300 ml/Ha	25 ml/20 L

MERIT 150SC AVAILABLE PACKS

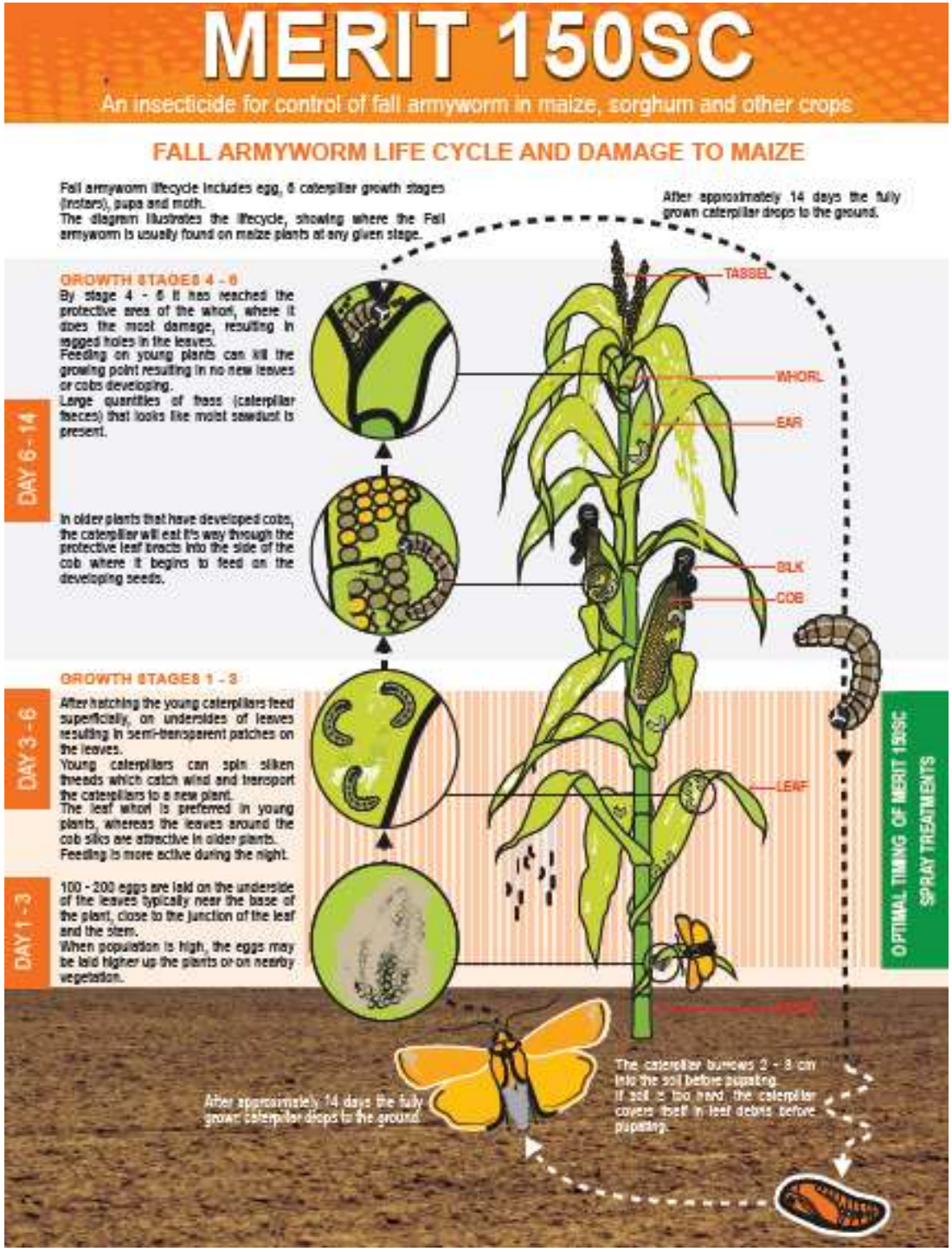
Pack Size	Sprayable Area	No. of Knapsack Sprayer
50 ml	0.4 Acres	2
100 ml	0.8 Acres	4
250 ml	2.0 Acres	10
500 ml	> 4.0 Acres	20
1 L	> 8.0 Acres	40

RESISTANCE MANAGEMENT

- ✓ Fall armyworm is prone to develop resistant on insecticides and has become resistance to commonly used insecticides.
- ✓ Repeated or exclusive use of MERIT 150SC may cause resistance problem.
- ✓ To delay resistance development, do not make more than **2 consecutive sprays of MERIT 150SC** without alternating with other effective products of different mode of action.
- ✓ Growers are advised to make 2 consecutive sprays of MERIT 150SC then alternate with: **BELT 480SC**

or

CORAGEN 200SC


MERIT 150SC
An insecticide for control of fall armyworm in maize, sorghum and other crops
FALL ARMYWORM LIFE CYCLE AND DAMAGE TO MAIZE
Fall armyworm lifecycle includes egg, 6 caterpillar growth stages (instars), pupa and moth.
The diagram illustrates the lifecycle, showing where the Fall armyworm is usually found on maize plants at any given stage.
After approximately 14 days the fully grown caterpillar drops to the ground.
GROWTH STAGES 4 - 6
By stage 4 - 6 it has reached the protective area of the whorl, where it does the most damage, resulting in ragged holes in the leaves.
Feeding on young plants can kill the growing point resulting in no new leaves or cobs developing.
Large quantities of frass (caterpillar faeces) that looks like moist sawdust is present.
DAY 6 - 14
In older plants that have developed cobs, the caterpillar will eat it's way through the protective leaf bracts into the side of the cob where it begins to feed on the developing seeds.
GROWTH STAGES 1 - 3
DAY 3 - 6
After hatching the young caterpillars feed superficially, on undersides of leaves resulting in semi-transparent patches on the leaves.
Young caterpillars can spin silken threads which catch wind and transport the caterpillars to a new plant.
The leaf whorl is preferred in young plants, whereas the leaves around the cob silks are attractive in older plants.
Feeding is more active during the night.
DAY 1 - 3
100 - 200 eggs are laid on the underside of the leaves typically near the base of the plant, close to the junction of the leaf and the stem.
When population is high, the eggs may be laid higher up the plants or on nearby vegetation.
TASSEL
WHORL
EAR
SILK
COB
LEAF
OPTIMAL TIMING OF MERIT 150SC SPRAY TREATMENTS
After approximately 14 days the fully grown caterpillar drops to the ground.
The caterpillar burrows 2 - 8 cm into the soil before pupating. If soil is too hard, the caterpillar covers itself in leaf debris before pupating.