Managing the Fall Armyworm Threat Using the Push–Pull Technology
The peace and quiet of the early morning... ...is broken by an agonised scream.

The villagers respond in arms ready to chase the normal threat to their farms. Elephants and baboons.

At the farm, there are no wild animals attacking their crop.

What is the distress call about? There are no wild animals in the farm?

Can’t you see the destruction on our maize crop?

This is witchcraft! Our crop has been destroyed by hailstones yet we have had no rains recently!

We have to find the witch or wizard responsible for this!

See, they have even poured sawdust onto the crop. This is a punishable offense!

Look! These must be the symptoms of damage by Fall armyworm pest.

Yes, we learnt about it during the Agricultural show. This infestation is so serious!

What did you learn at the Agricultural show? Are you saying this maize has been destroyed by some pest?
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Well done children. I am happy to know that you are sharing the lessons you learned about the Fall armyworm with your parents!

That is not sawdust. It is frass, which is caterpillar poo. Look! the Agricultural extension officer who taught us about the Fall armyworm is coming. She can explain more.

If you inspect the whorls of the affected plants, you will see Fall armyworm caterpillars.

Yes, the hailstone-like damage you see on the maize has been caused by a pest known as the Fall armyworm (Spodoptera frugiperda).

Yes, they cause elongated, ragged holes and may cut leaves into half. If the pest is not controlled, it can cause up to 100% yield loss.

What about the sawdust?

Fall armyworm is a highly destructive pest on cereal crops and other important cultivated plants.

The Fall armyworm head is covered with a dark net-like pattern and what looks like an upside down white 'Y' marking.

Broad, pale band along top of the body, contrasted by dark striping at the sides.

The egg masses are covered in protective scales. After hatching, the young caterpillars begin feeding on the leaves.

The eighth abdominal segment has four dark spots.

Lateral view of the fall armyworm

Dorsal view of the fall armyworm

I see a caterpillar.
The Fall armyworm life cycle includes four growth stages: egg, six growth stages of caterpillar development (instars), pupa and moth.

This diagram illustrates the life cycle, showing where to find the fall armyworm on maize plants at any given stage.

**GROWTH STAGES 1–3**
- After hatching the young caterpillars feed superficially, usually on the undersides of leaves. Feeding results in semi-transparent patches on the leaves called windows.
- Young caterpillars can spin silken threads that catch the 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.
- Eggs (100–200) are generally laid on the underside of leaves, typically near the base of the plant, close to the junction of the leaf and the stem. The eggs are covered in protective scales rubbed off from the moth’s abdomen after laying.
- The eggs may be laid higher up the plants or on nearby vegetation when the populations are high.

**DAY 1–3**
- After approximately 8–9 days, the adult moth emerges to restart the cycle.

**GROWTH STAGES 4–6**
- By stage 3–6 it will have reached the protective region 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.
- Often only 1 or 2 caterpillars are found in each whorl, as they become cannibalistic when larger and will eat each other to reduce competition for food.
- Large quantities of frass (caterpillar excrement) are present. When this dries, it resembles sawdust.
- If the plant is older and has already developed cobs, then the caterpillar will eat its way through the protective leaf bracts into the side of the cob where it begins to feed on the developing kernels (seeds).
- After approximately 14 days the fully grown caterpillar will drop to the ground.

**DAY 6–14**
- After approximately 8–9 days, the adult moth emerges to restart the cycle.
- The caterpillar will then burrow 2–8 cm into the soil before pupating.
- The loose silk oval-shaped cocoon is 20–30 mm in length.
- If the soil is too hard, then the caterpillar will cover itself in leaf debris before pupating.
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Push–Pull technology is a cropping system, where cereal crops are inter-cropped with Desmodium legume and the plot surrounded by Napier or Brachiaria grass border, for controlling Striga weed, stem-borers and Fall armyworm pests. Desmodium planted between the rows of maize, repel the pests (push) and control the parasitic Striga weed, while the border grasses attract (pull) the stemborer moths to lay their eggs, however they do not support larval development, thus managing the pest population naturally.

How does Fall armyworm spread?

The adult moth can fly between 30–100 km in one night. The female lays 1500–2000 eggs in her lifetime.

Does it feed on other crops?

Fall armyworm prefers maize, but can feed on more than 80 varieties of plants including sorghum, millet and rice.

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There is no need to worry though. Fall armyworm can be managed using the Push–Pull technology.

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How do we establish a Push–Pull plot?

Members of the United Elite Farmer Field School will show you how to establish and maintain a Push–Pull plot.

THE UNITED ELITE FARMER FIELD SCHOOL DEMONSTRATE HOW TO ESTABLISH A PUSH–PULL PLOT

Clear the land and plough ...

... then break down the soil until it is fine.

Using pegs and ropes, measure a plot of 30m x 30m. A Push–Pull plot can be as small as 20m x 20m, or as big as any cultivated plot of ground.
Put pegs at opposite sides of the field at intervals of 75cm each. When the plot has been marked with pegs and strings, it should look like this.

**PLANTING BRACHIARIA GRASS.**

Brachiaria can be planted by use of root splits or seed.

1. Dig holes along the demarcated lines ready for planting.
2. Apply two hand-fulls of well decomposed farmyard manure in each hole.
3. Place Brachiaria root splits upright into the planting holes and cover with soil.

Brachiaria grass is used in the climate-smart Push-Pull technology that is recommended for dry areas. A well established climate-smart Push-Pull plot should look like this after 5 weeks.
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**IF PLANTING NAPIER GRASS.**

Dig holes along the demarcated lines ready for planting.

**SELECT HEALTHY NAPIER GRASS**

Select healthy Napier grass for planting. Do not plant Napier grass that has stunt disease.

**FOLLOW THESE STEPS WHEN PLANTING NAPIER GRASS IN YOUR PUSH–PULL PLOT.**

1. Dig holes at each peg on border of the marked plot.
2. Apply one teaspoonful of triple super phosphate fertilizer or 2 hand-fulls of well decomposed farmyard manure in each hole.
3. Place a three node cane into each hole at an angle of 30° to 40° all facing one direction.
4. Cover with soil ensuring that two nodes of the cane are well covered.
5. Repeat steps 1 to 4 for the second and third rows, ensuring that the rows are 75cm apart and 75cm between the plants within the rows.
6. If you are using root splits, place them upright into the planting holes and cover with soil.

**HOW TO PLANT DESMODIUM WHEN ESTABLISHING A PUSH–PULL PLOT**

After planting Brachiaria or Napier grass, you need to plant Desmodium next. To plant Desmodium, mix 250g of Desmodium seed with fine sand; one part desmodium to three parts dry sand.

Mix 3 parts sand to 1 part desmodium seed.
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Drill DAP fertilizer or farmyard manure along furrows, mix with soil using a stick, without covering or disturbing the furrow.

PLANT MAIZE BETWEEN THE DESMODIUM ROWS.

Drill Desmodium in furrows at 75cm row-to-row distance.

WEEDING AND CROP MANAGEMENT.

Napier grass and silverleaf Desmodium are used in conventional Push-Pull recommended for areas with adequate rainfall.

Early weeding is very important for the successful establishment of a Push–Pull plot. We carried out the first weeding when maize was 3 weeks old, and second weeding when maize was 5 weeks old. It is important to distinguish between desmodium and weeds.

HAND WEEDING DESMODIUM
BY THE FOLLOWING PLANTING SEASON, THE VILLAGE HAD ADOPTED THE PUSH–PULL TECHNOLOGY AND HAVE THE FOLLOWING GAINS.

The agricultural extension officer meeting the group of farmers two seasons later.

You have been planting maize under the Push–Pull system the last two seasons. What changes have you seen in your farms?

Fall armyworm did not damage maize in my Push–Pull plot.

I harvested more maize in the second season.

The Napier or Brachiaria borders and Desmodium in the Push–Pull plots have controlled soil erosion significantly!

My dairy cows and goats feed on Brachiaria, Napier grass and Desmodium from the Push–Pull plot and now produce more milk.

We make Brachiaria and Desmodium hay, and sell to other dairy farmers. We also make silage from Napier grass.
Push-Pull system has helped us to understand proper maize agronomic practices. We have learned the importance of planting early, using the right seeds, timely weeding and monitoring the farms for any pest infestation. My farm is my office, I have to attend to it.

Officer, many farmers are now asking to be trained on the technology, but where can they get Desmodium seeds?

Desmodium and Brachiaria seeds can be sourced from our seed partners in the following countries:
- In Burkina Faso: INERA (Institut de l’Environnement et Recherches Agricoles).
- In Burundi: ISABU (Institut des Sciences Agronomiques du Burundi).
- In Rwanda: Alexis Business Limited.
- In South Africa: Barenbrug seeds and Napier can be established through stem cuttings or root splits.
- In Zimbabwe: Grasslands research station, Kuzhereketa Rural Development, Mukushi seeds.

For more information, contact Technology Transfer Unit at icipe, Nairobi, Kenya.
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The International Centre of Insect Physiology and Ecology (icipe) was established in 1970 in direct response to the need for alternative and environmentally-friendly pest and vector management strategies. Headquartered in Nairobi, Kenya, icipe is mandated to conduct research and develop methods that are effective, selective, non-polluting, non-resistance inducing, and which are affordable to resource-limited rural and urban communities. icipe’s mandate further extends to the conservation and utilisation of the rich insect biodiversity found in Africa. icipe’s Capacity Building Programme aims to promote the development and utilisation of sustainable arthropod management technologies by enhancing the research and training capabilities of countries in Africa. The Centre’s major areas of capacity building activity are: (i) Capacity building and professional development of university lecturers, researchers, and professionals in insect and related sciences; (ii) institutional development by nurturing and strengthening higher education, research and extension institutions; (iii) promoting innovations on insect science, in collaboration with regional and national agricultural research and advisory services, and the private sector. These objectives are realised through postgraduate training at PhD and MSc levels, professional development schemes for scientists, and non-degree training for technicians, scientists, community members and extension workers.

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