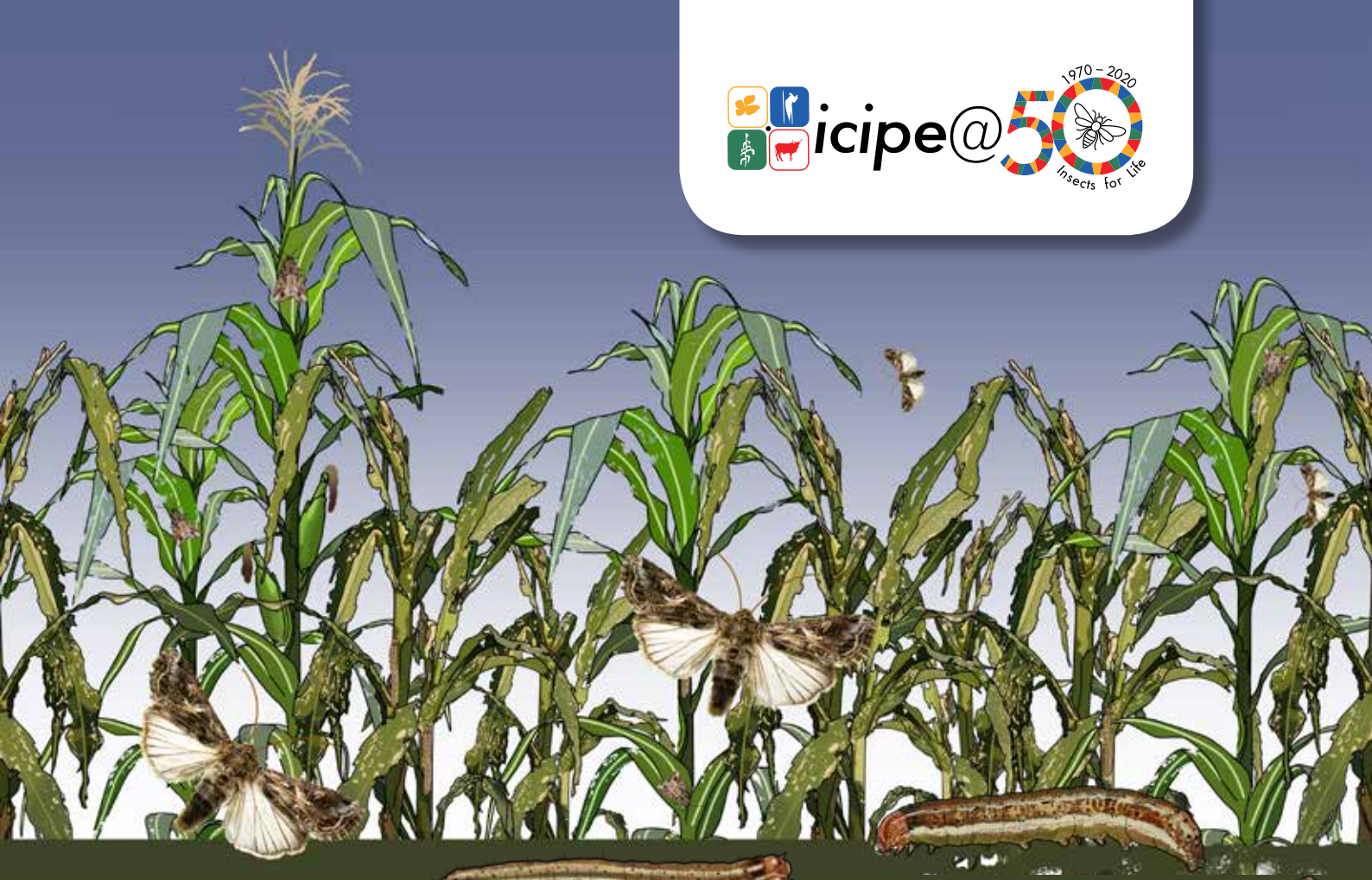
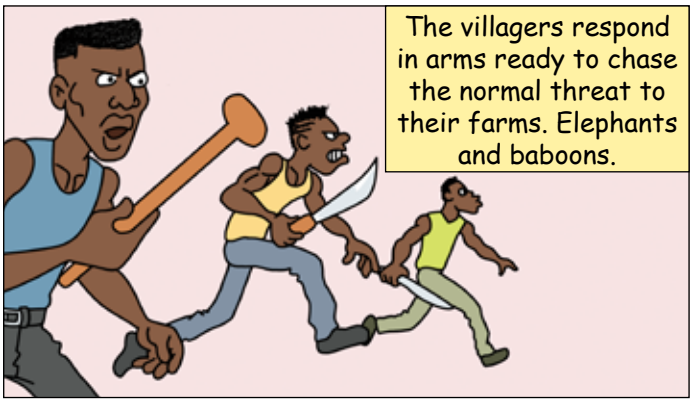


Managing the Fall Armyworm Threat Using the Push–Pull Technology

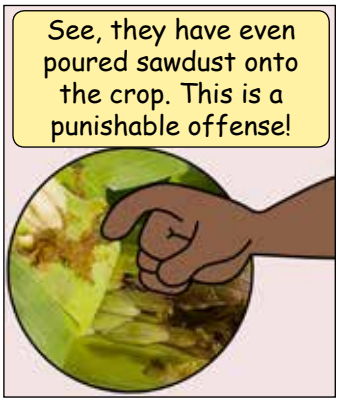
The peace and quiet of the early morning...

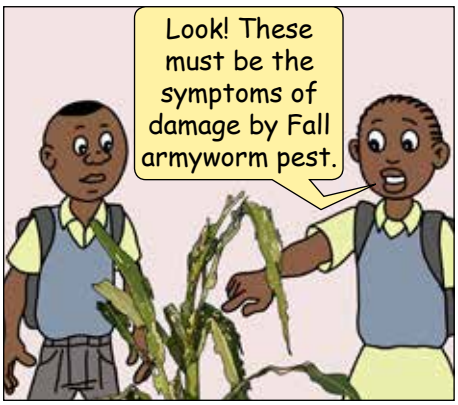
...is broken by an agonised scream.

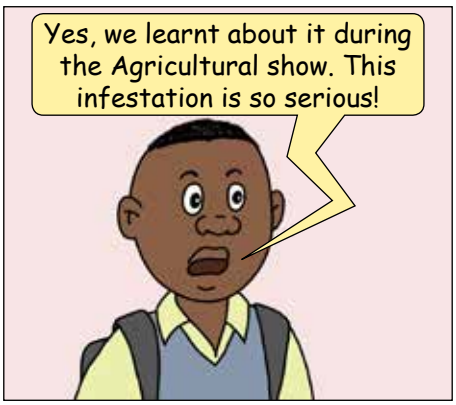


The villagers respond in arms ready to chase the normal threat to their farms. Elephants and baboons.

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







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?

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.

Well done children. I am happy to know that you are sharing the lessons you learned about the Fall armyworm with your parents!

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

I see a caterpillar.

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.

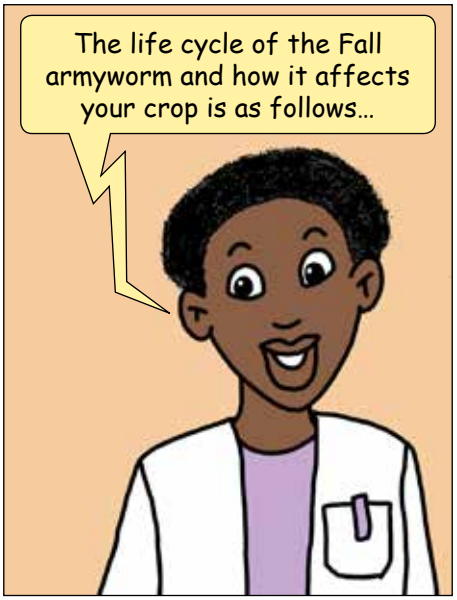
Broad, pale band along top of the body, contrasted by dark striping at the sides.

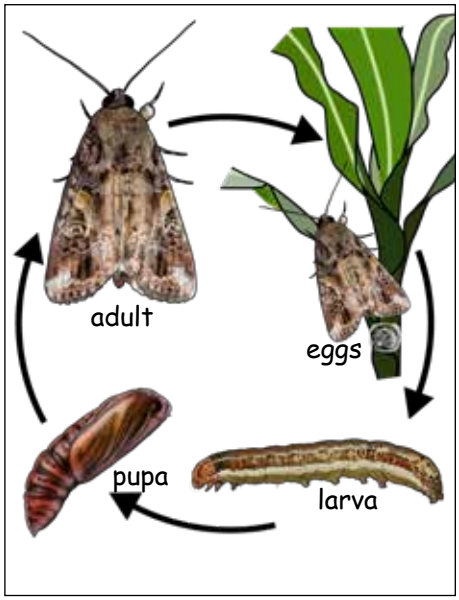
Lateral view of the fall armyworm

The eighth abdominal segment has four dark spots

Dorsal view of the fall armyworm

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





Fall armyworm: Life cycle and damage to maize

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.

DAY 6–14

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).

DAY 3–6

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.

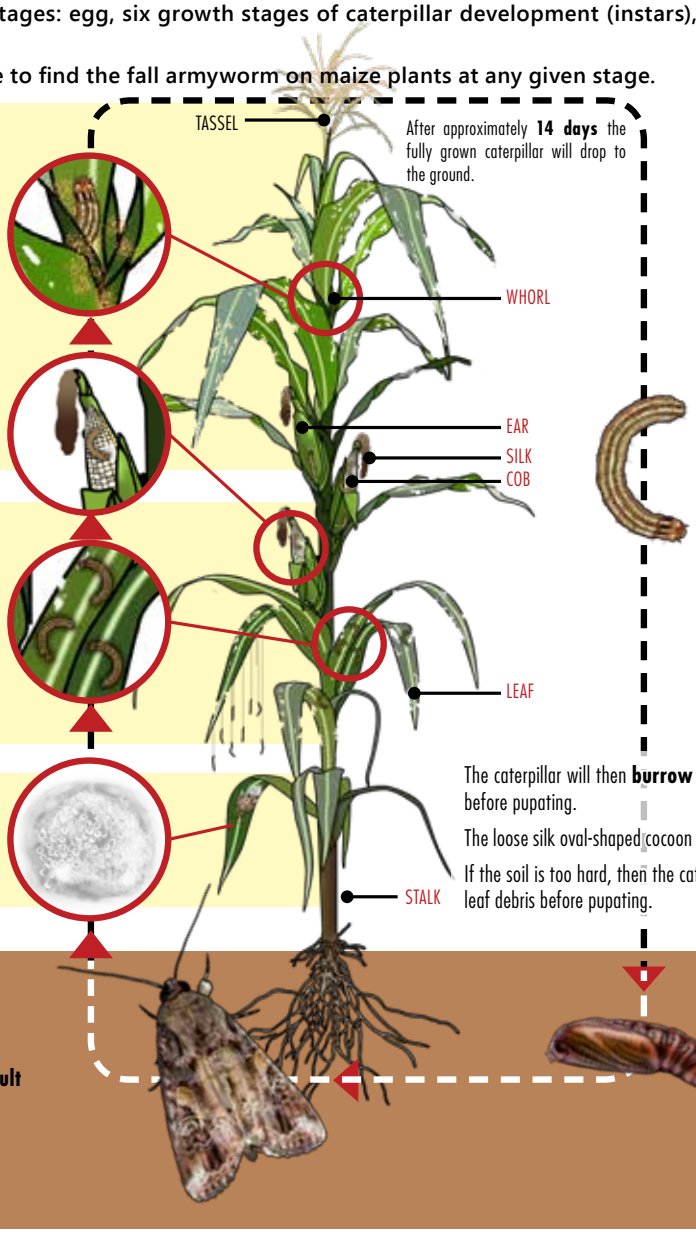
The leaf whorl is preferred in young plants, whereas the leaves around the cob silks are attractive in older plants.

Feeding is more active during the night.

DAY 1–3

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.



After approximately **14 days** the fully grown caterpillar will drop to the ground.

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.

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

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?

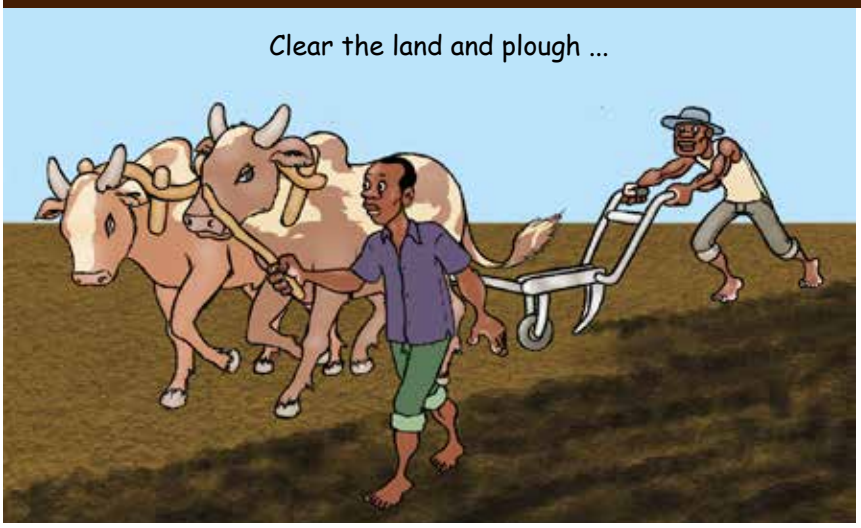
Fall armyworm prefers maize, but can feed on more than 80 varieties of plants including sorghum, millet and rice.

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

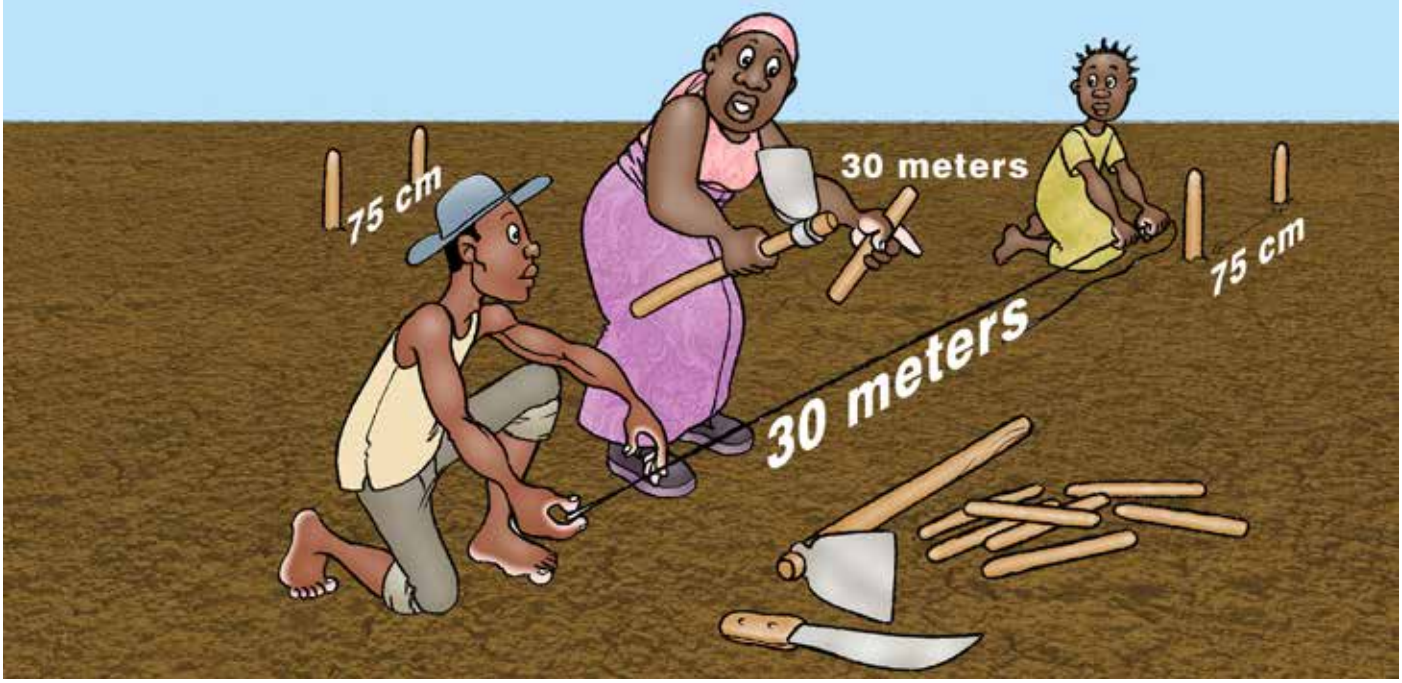
What is push-pull technology?

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.

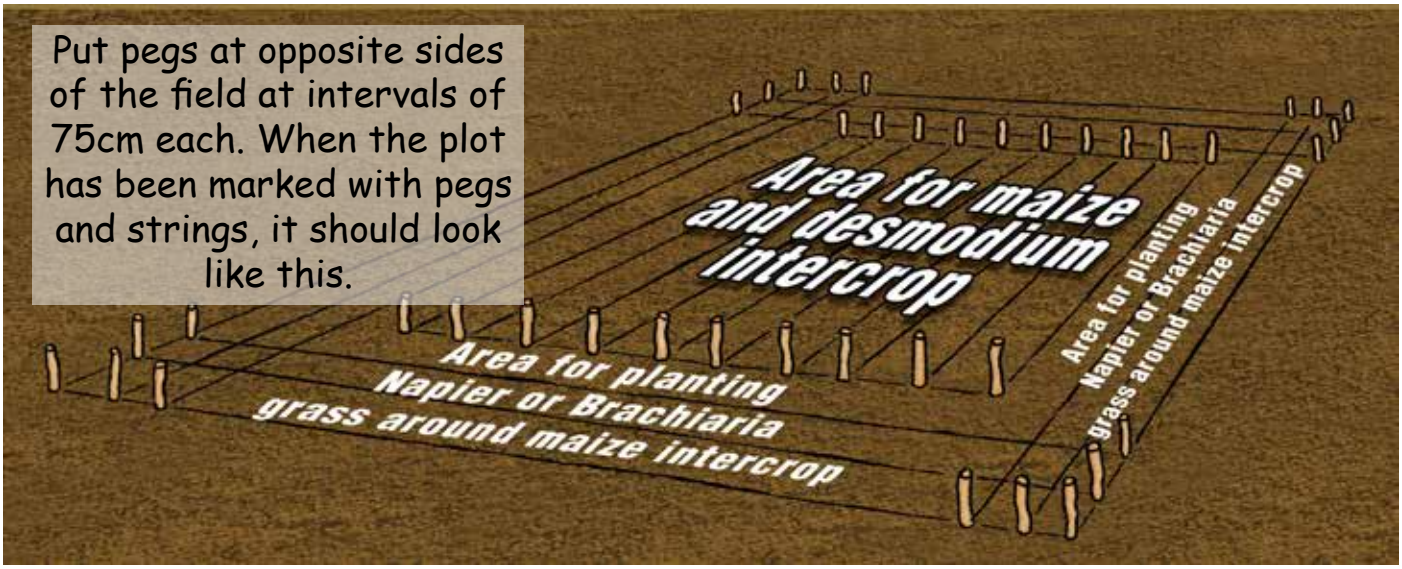
THE UNITED ELITE FARMER FIELD SCHOOL DEMONSTRATE HOW TO ESTABLISH A PUSH–PULL PLOT



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.

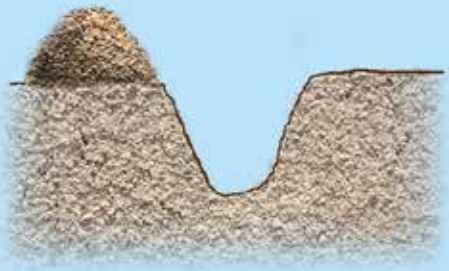


PLANTING BRACHIARIA GRASS.

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

TO PLANT BRACHIARIA USING ROOT SPLITS FOLLOW THESE STEPS.

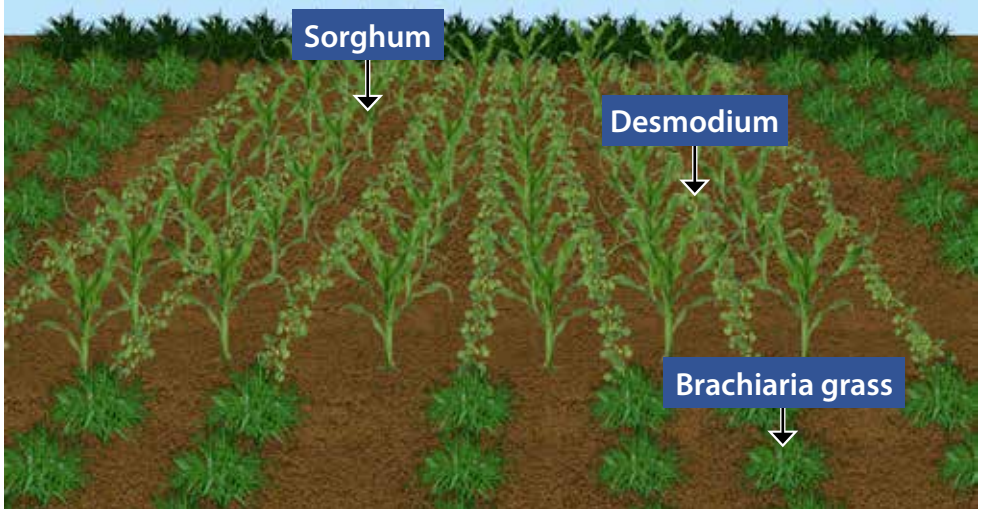
1. Dig holes along the demarcated lines ready for planting.



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.

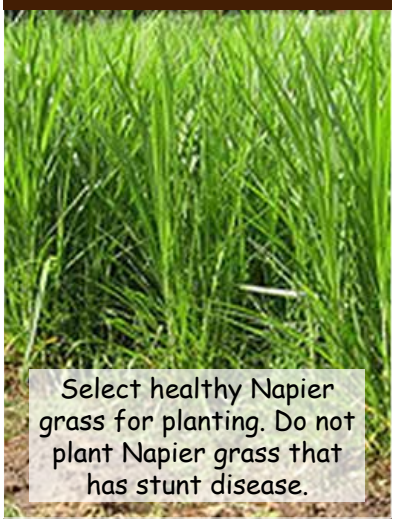
Brachiaria grass is used in the climate-smart Push-Pull technology that is recommended for dry areas. A well established climate-smart Push-Pull plot should look like this after 5 weeks.



IF PLANTING NAPIER GRASS.

Dig holes along the demarcated lines ready for planting.

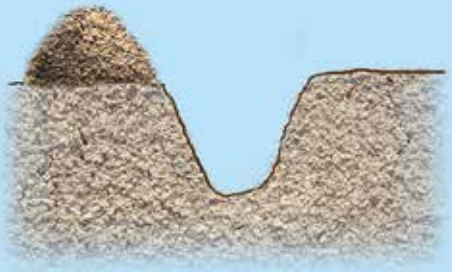
SELECT HEALTHY NAPIER GRASS



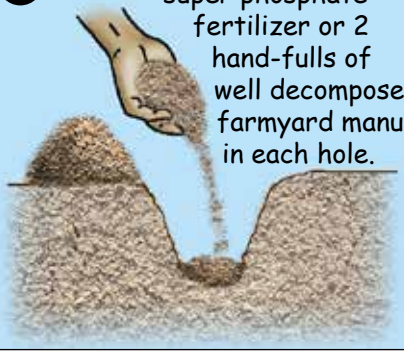
Select healthy Napier grass for planting. Do not plant Napier grass that has stunt disease.

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

1. Dig holes at each peg on border of the marked plot.



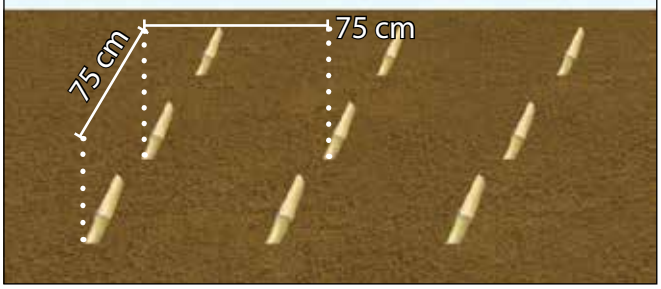
2. Apply one teaspoonful of triple super phosphate fertilizer or 2 hand-fulls of well decomposed farmyard manure in each hole.



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.



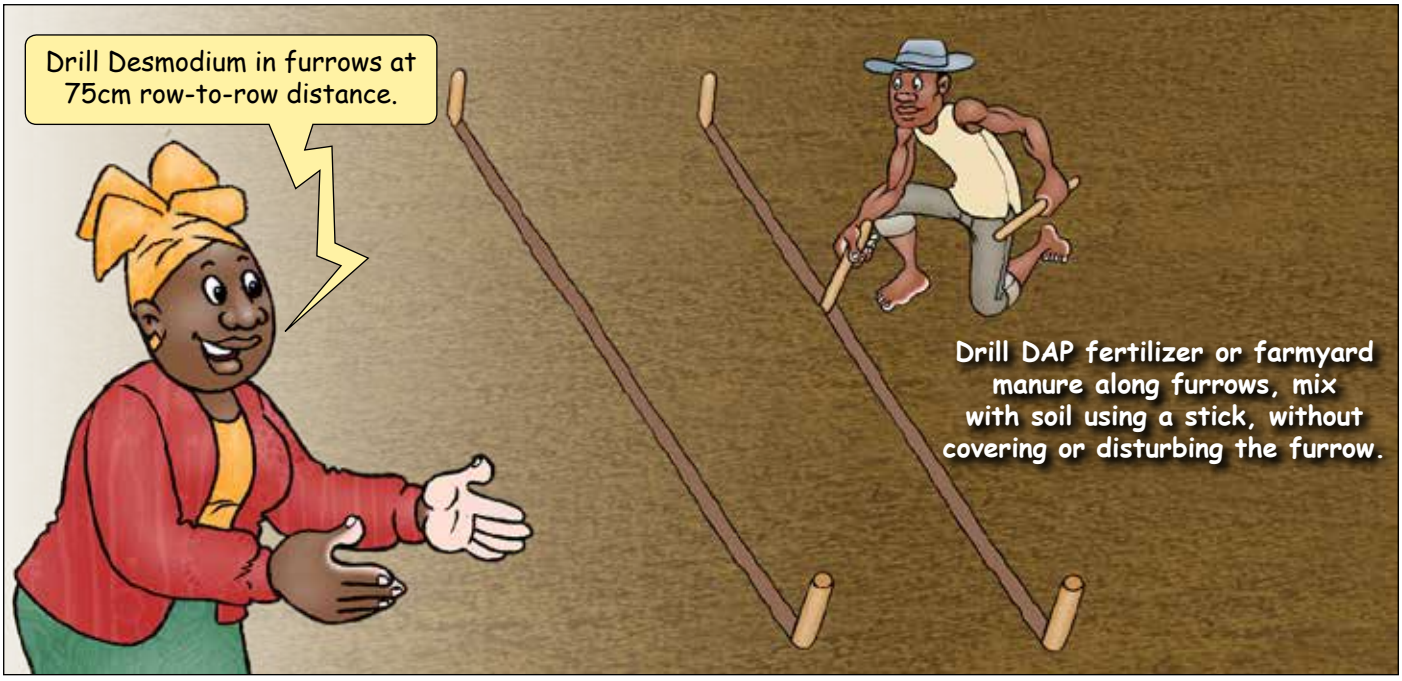
6. If you are using root splits, place them upright into the planting holes and cover with soil.

HOW TO PLANT DESMODIUM WHEN ESTABLISHING A PUSH–PULL PLOT

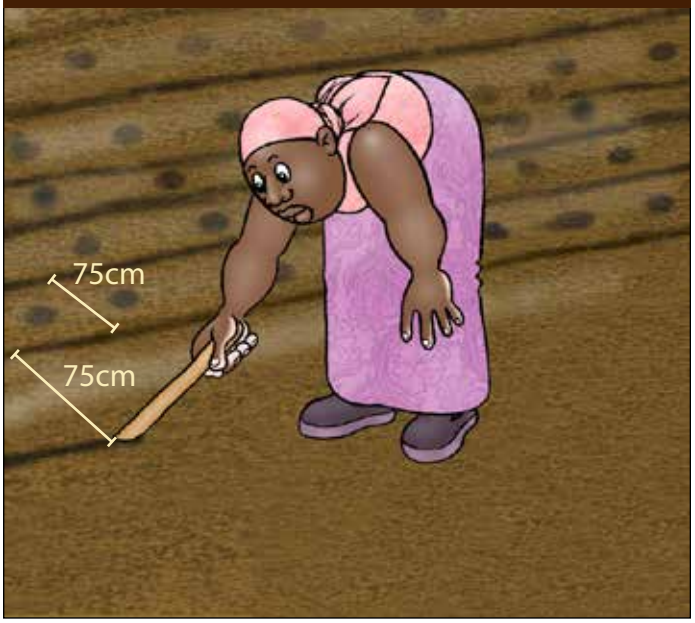
After planting Brachiaria or Napier grass, you need to plant Desmodium next, To plant Desmodium, mix 250g of Desmodium seed with fine sand; one part desmodium to three parts dry sand.

Desmodium Fine Sand

Mix 3 parts sand to 1 part desmodium seed.

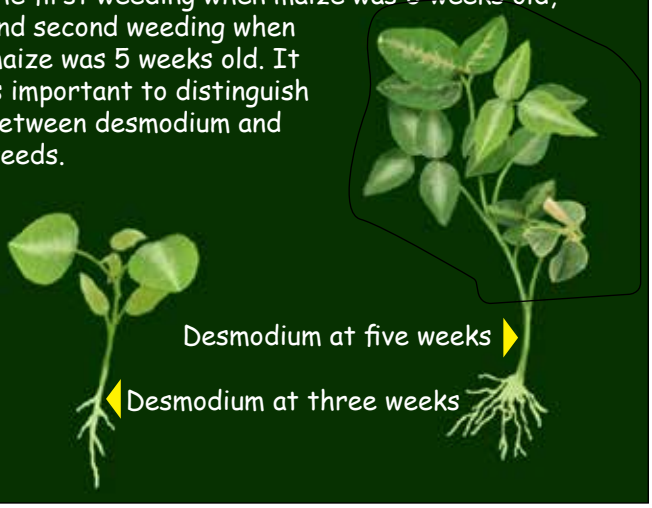


PLANT MAIZE BETWEEN THE DESMODIUM ROWS.



WEEDING AND CROP MANAGEMENT.

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.

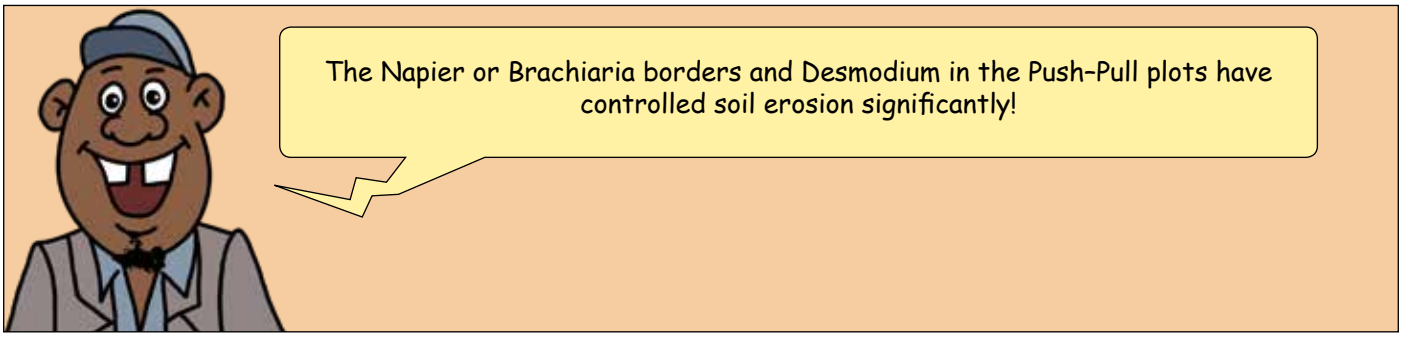


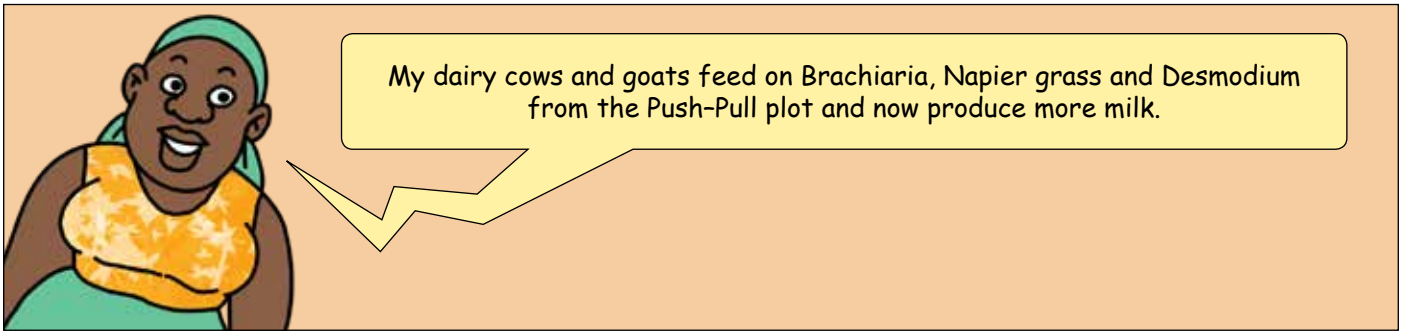
HAND WEEDING DESMODIUM

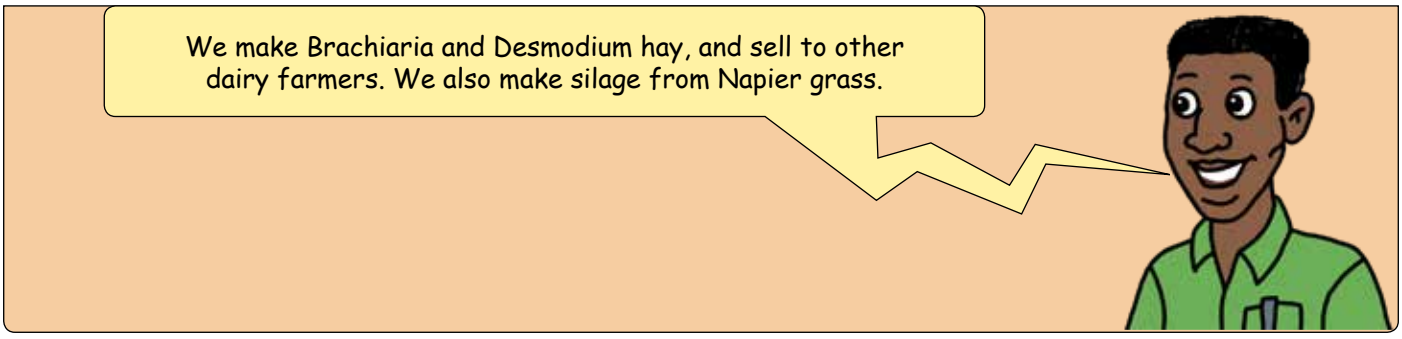
Napier grass and silverleaf Desmodium are used in conventional Push-Pull recommended for areas with adequate rainfall.

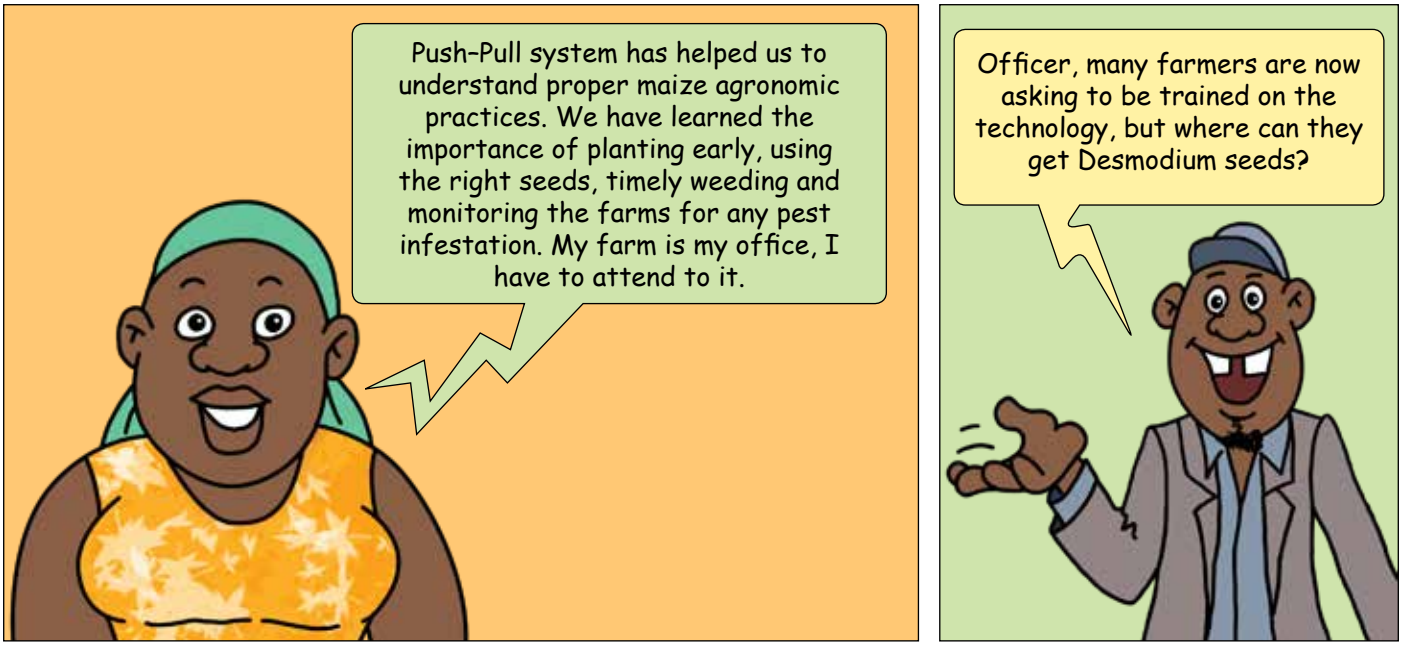
BY THE FOLLOWING PLANTING SEASON, THE VILLAGE HAD ADOPTED THE PUSH–PULL TECHNOLOGY AND HAVE THE FOLLOWING GAINS.

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









Correct citation

icipe 2019. Managing the Fall Armyworm Threat Using the Push–Pull Technology. International Centre of Insect Physiology and Ecology, Nairobi, Kenya.

ISBN 978-9966-063-45-8

Editors: Z. R. Khan, C. A. O. Midega, J. Pittchar, Rachel Owino, George Genga, D. Nyagol, A. Ndiege, S. Niassy, V. Koech (*icipe*, Kenya)
Storyline, Illustrations, Design and Layout: Skyward Design and Marketing Ltd., Nairobi, Kenya

For more information, contact:

Director General
International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100 Nairobi, Kenya
Tel.: +254 (20) 8632000
Fax: +254 (20) 8632001, 8632002
E-mail: icipe@icipe.org

or

Push–pull Programme
icipe-Mbita
P. O. Box 30 -40305
Mbita
Kenya
Tel.: +254 (57) 2053201

or

Technology transfer unit at icipe
ttucrew@icipe.org
+254 0110 941 839

or

County and Sub-county Agriculture Offices

icipe – Working in Africa for Africa...

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.

DONORS: European Union; UK Aid from the UK Government; Biovision Foundation, Switzerland; BBSRC, UK, Norad, Norway

COLLABORATORS: Kenya Agricultural and Livestock Research Organisation (KALRO); and Ministry of Agriculture (MOA), Kenya. Visit: www.pull–pull.net

ACKNOWLEDGEMENT: We gratefully acknowledge the financial and technical support of our core donors: Swiss Agency for Development and Cooperation (SDC), Switzerland; Swedish International Development Cooperation Agency (Sida), Sweden; UK Aid, Government of the United Kingdom; Ministry of Higher Education, Science and Technology, Kenya; and Government of the Federal Democratic Republic of Ethiopia. We also recognise specific restricted project donors and partners.

International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100 Nairobi, Kenya
Email: ttucrew@icipe.org | Website: www.technologytransfer.icipe.org
Email: icipe@icipe.org | Website: www.icipe.org
Support icipe: www.icipe.org/support-icipe

EUROPEAN UNION

BBSRC bioscience for the future

biovision

Norad

UKaid from the British people