A Primer on Planting and Managing 'Push-Pull' Fields for Stemborer and Striga Weed Control in Maize

A Step-by-Step Guide for Farmers and Extension Staff

2nd Edition




Z. R. Khan, F. N. Muyekho, E. Njuguna, J. A. Pickett, L. J. Wadhams, J. Pittchar, A. Ndiege, G. Genga, D. Nyagol, and C. Lusweti

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FOREWORD

Stemborers and striga weed are the major pests of maize throughout Africa. Maize yield losses due to stemborers can vary from 20-40%. Striga weed infests 40% of arable land in the savanna region, causing an annual crop loss of 7 to 13 billion dollars. Around the Lake Victoria basin, infestation by striga weed causes 30 to 100% loss in maize yield.

Spraying for stemborer control with pesticides is not only expensive and harmful to the environment, but is also ineffective. Weeding for striga control is both time-consuming and labour-intensive.

The 'push-pull' habitat management approach – developed by ICIPE, in partnership with several institutions including the Kenya Agricultural Research Institute (KARI), the Kenya Ministry of Agriculture and Rothamsted Research UK, exploits chemical ecology and biodiversity in a novel manner to limit crop losses to stemborers and striga weeds. At same time, it conserves soil and water while preserving biodiversity.

The 'push-pull' technology involves trapping stemborers on highly attractant trap plants (the pull) and driving them away from the maize crop using repellant intercrops (the push). Plants which repel stemborers as well as inhibit striga, have also been identified. These plants also provide high quality feed for livestock, thereby increasing their productivity in terms of meat and milk. On-farm trials with over 10,000 farmers in eastern Africa have confirmed that these approaches conducted separately and together, result in significant yield increases.

‘Push-pull’ is a ‘platform technology’ around which other agricultural innovations can develop to bring about an overall improvement in the farming systems and livelihoods. It simultaneously reduces crop losses; improves productivity, household nutrition and incomes; it enables increased production of livestock fodder; addresses soil fertility constraints and enables a minimum tillage system.

The technology has been disseminated through different pathways to enable as many farmers as possible learn about it, including print media, radio, farmer teachers, drama, field days and farmer field schools. Practical guides such as this handbook, a flyer on how to plant and manage a ‘Push-pull’ field, and the ‘push-pull’ farmer field school curriculum have also been published.

This handbook is published to guide farmers and frontline extension staff on how to establish and manage a ‘push-pull’ plot to control stemborer and striga weed. It is expected that these will enhance adoption of the technology and increase maize and livestock productivity while improving soil fertility and conserving the environment.

ICIPE and the authors of this handbook gratefully acknowledge the financial support from various donors – the Kilimo Trust, Uganda; Gatsby Charitable Foundation, UK; and Biovision, Switzerland – that have enabled us to develop and catalyze the dissemination of the ‘push-pull’ technology in eastern Africa.

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Stemborers and Striga Weeds

Stemborers and striga weeds are the two most destructive pests of cereal crops and can greatly reduce yields of maize and sorghum on smallholder farms. These pests can cause yield losses of 30 to 100% if they are not controlled. Control of stemborers by insecticides and control of striga weeds by herbicides is very expensive for resource-poor farmers and can also be harmful to the environment.

Stemborers

Stemborers are the most important insect pests of maize in Africa, but they also attack other cereal crops such as sorghum, millet and sugarcane. In eastern Africa there are two species of stemborers which cause heavy damage to cereal crops:

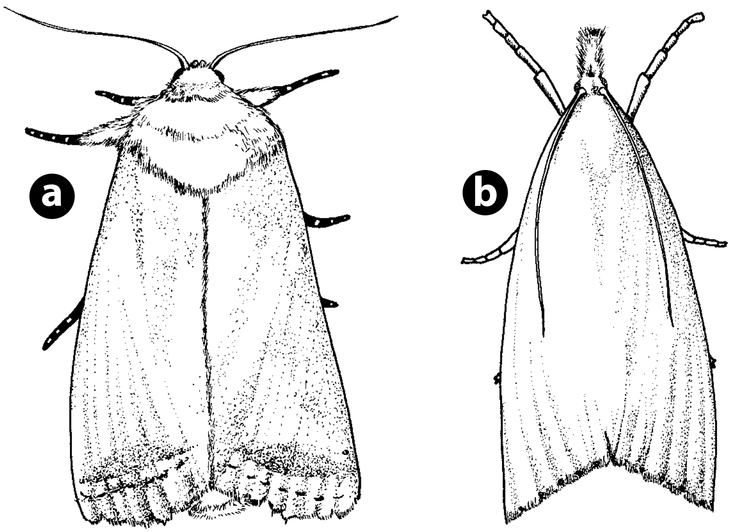


*Figure 1. Adult stemborer moths of **Busseola fusca** (a) and **Chilo partellus** (b)*

Busseola fusca (Figure 1a) and *Chilo partellus* (Figure 1b). *Busseola fusca* is indigenous to Africa and is present in high and mid-altitude areas (3500ft [1077m] above sea level and higher). *Chilo partellus* accidentally came to Africa from Asia in the 1930s. *Chilo partellus* is present in low and mid-altitude areas (zero to 4000ft [1230 m] above sea level).

Damage is caused by the worm-like larvae, which first feed on young leaves (Figure 2), but soon enter into the stems.

Figure 2. Maize plant damaged by stemborer larvae

During the early stage of crop growth, the larvae may kill the growing points of the plant, resulting in deadheart (Figure 3).

At a later stage of growth, the larvae make extensive tunnels inside the stem (Figure 4). This weakens the stalk so that it breaks and 'lodges' (falls over). Damage caused by stemborers averages 20 to 40% which means between 2-4 bags of maize are lost out of every 10 that could be harvested.

FIgure 3. Deadheart caused by stemborer larvae feeding inside maize plants

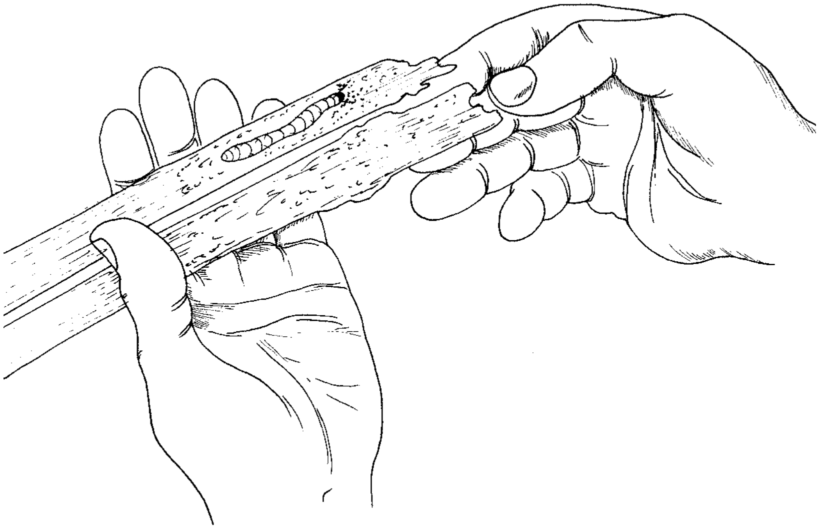


Figure 4. A stem borer larva feeding inside a maize stem

The adult moths of stemborers (Figure 1) are seldom seen in farmers' fields as they are inactive during daytime. They become active after sunset and lay their eggs during the night.

Adult moths lay their eggs on maize plants; after the larvae emerge, they feed on leaves for two to three days and then enter inside the maize stem (Figure 4). *Busseola fusca* lays its eggs between the stem and leafsheath, whereas '*Chilo partellus* lays its eggs on the leaf surface in the form of egg batches (Figures 5 and 6). After the larvae bore into the maize stems, they feed and grow within the stems for 2-3 weeks.

When the larvae are fully grown, they pupate and remain inside the maize stem. After 7-14 days the adults emerge from the pupae and come out of the stem. They mate and lay eggs on the maize plants again and continue damaging the crop.

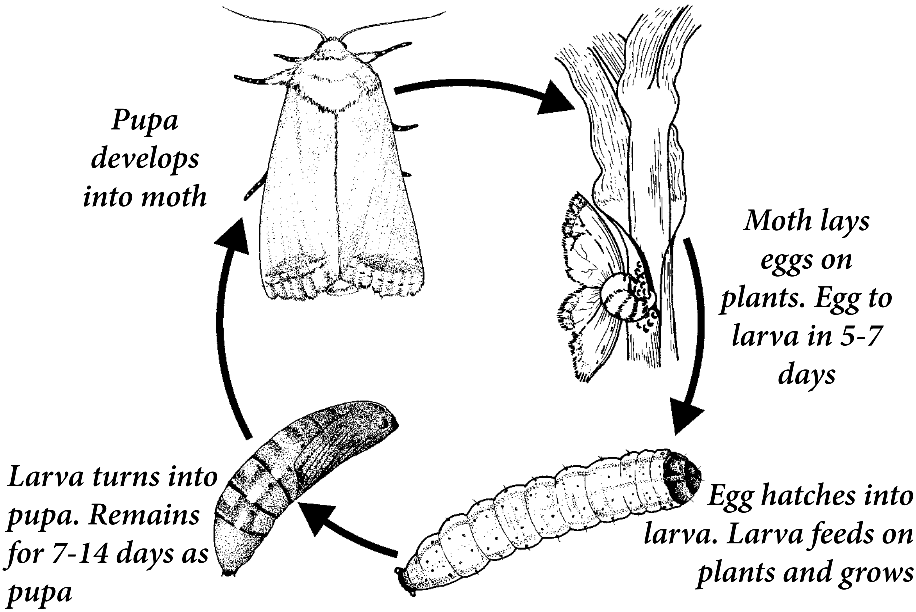


Figure 5. Life cycle of the stemborer **Bussela fusca**

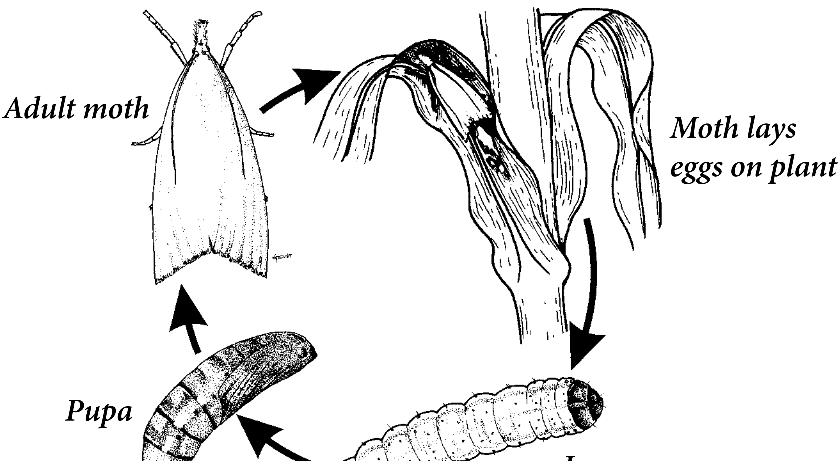


Figure 6. Life cycle of the stemborer **Chilo partellus**
(the spotted stemborer)

Striga weeds

Striga or 'witchweeds' are parasitic weeds that affect cereal crops in many parts of Africa, reducing production from 30 to 100%, or complete loss of the crop. If maize plants are attacked by both stemborers and striga weed, the yield loss is often 100%. In East Africa, there are two common species of the witchweed, *Striga hermonthica* (Figure 7) and *Striga asiatica*. *Striga hermonthica* is common around the Lake Basin, while *Striga asiatica* is mainly found in the coastal areas. The most affected crops are maize, sorghum, rice and sugarcane.

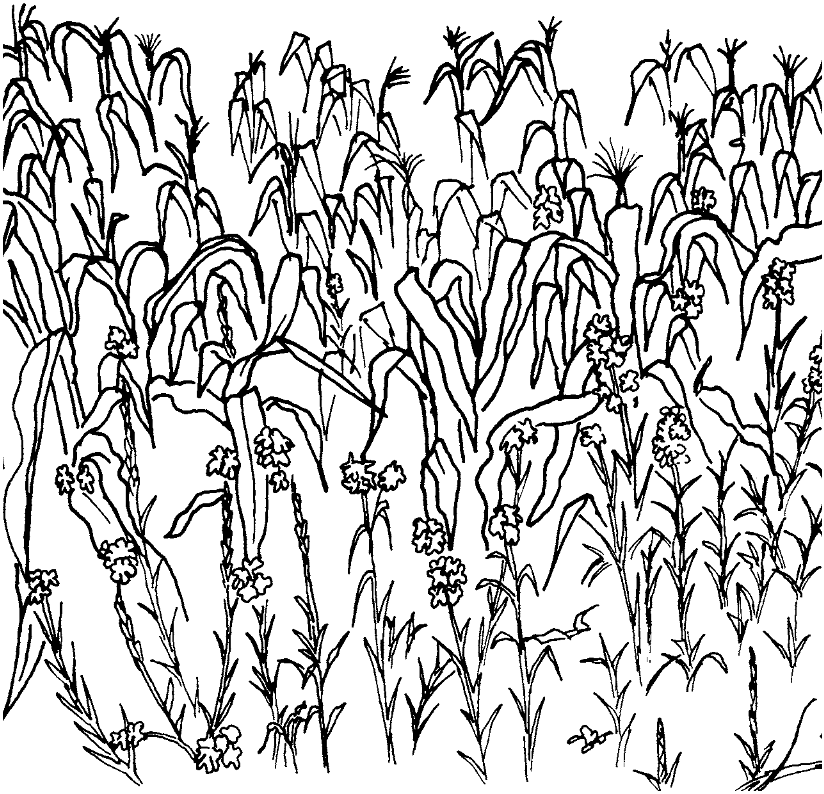


Figure 7. A maize field infested with Striga hermonthica

When a farm is infested with striga, the affected plants seldom grow more than one foot (30 cm) tall. The weed does not put roots into the soil so as to grow on its own, but grows by attaching itself onto the host (e.g. maize) plant (Figure 8).

Each striga plant can produce up to 20,000-50,000 seeds, which lie dormant in the soil until a cereal crop is planted again. This dormancy can last for over 15 years. As striga germinates, its roots grow towards the host crop. They penetrate that crop's roots and start to draw nutrients from the host. 'This causes severe stunting of the host crop and yield loss.

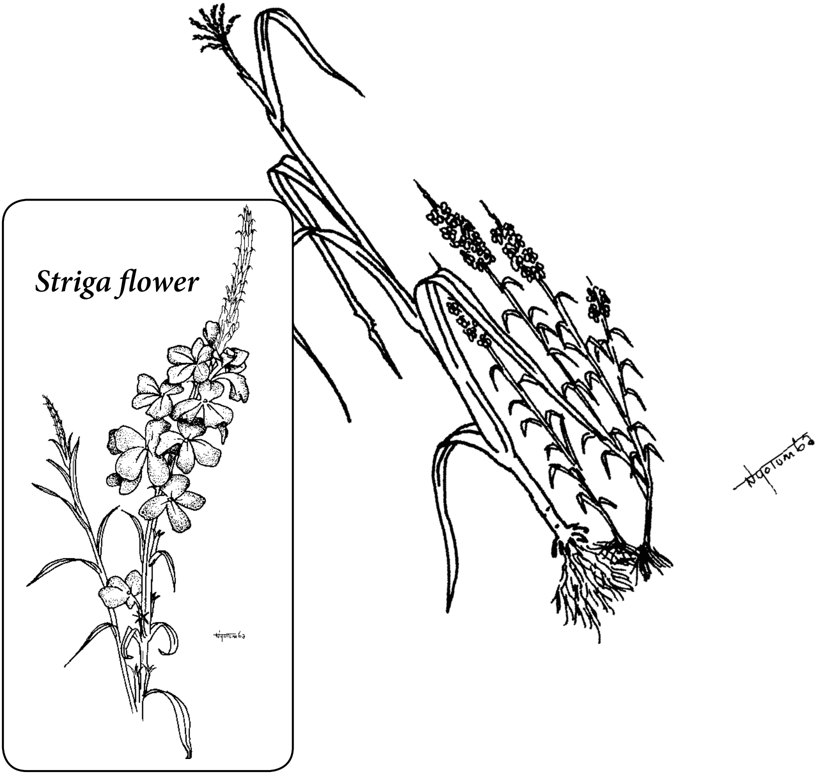


Figure 8. Striga weed attached to maize roots

Taking into account the peculiar nature of striga seeds, farmers are advised to control it before the weed emerges above the soil. The reason for this is that by the time it emerges, much of the damage to the maize will have been caused.

Although various control methods have been proposed, they are usually not successful. For example, although manual removal of the striga reduces re-infestation, it is considered uneconomical since most damage is done even before the weed emerges. Therefore, any control strategy has to begin *within* the soil.

Control of Stemborers and Striga Weeds Using a 'Push-Pull' Strategy

What is 'push-pull'?

ICIPE and her partners have developed an effective, low-cost and environmentally friendly technology known as 'push-pull' for the control of stemborers and suppression of striga weeds in maize. It is a simple cropping strategy, whereby farmers use Napier grass and desmodium legume (silverleaf and greenleaf desmodium) as intercrops.

Desmodium is planted in between the rows of maize. It produces a smell or odour that stemborer moths do not like. The smell 'pushes' away the stemborer moths from the maize crop.

Napier grass (*Pennisetum purpureum*) is planted around the maize crop as a trap plant. Napier grass is more attractive to stemborer moths than maize and it' pulls' the moths to lay their eggs on it (Figure 9). But Napier grass does not allow stemborer larvae to develop on it. When the eggs hatch and the small larvae bore into Napier grass stems, the plant produces a sticky substance like glue which traps them, and they die (Figure 10). So, very few stemborer larvae survive and the maize is saved because of the 'push-pull' strategy.

In addition, a ground cover of desmodium (*Desmodium uncinatum*, or silverleaf), interplanted among the maize, reduces striga weed. Research has shown that chemicals produced by the roots of desmodium are responsible for suppressing the striga weed. Therefore, striga does not grow where desmodium is growing. Being a legume, desmodium also fixes nitrogen in the soil and thus acts to enrich the soil.

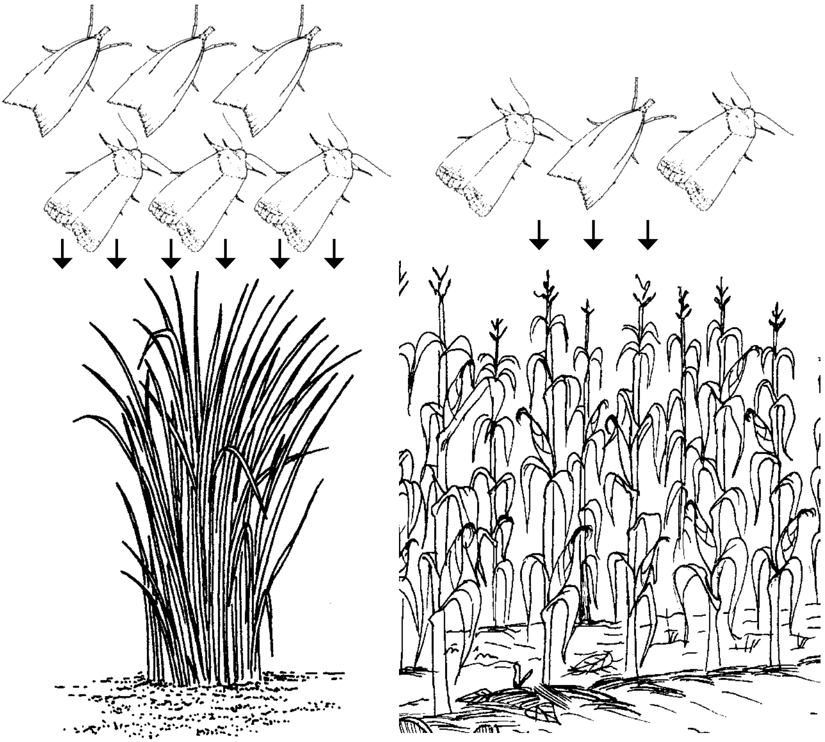


Figure 9. More stemborers moths are attracted to Napier grass than to maize. Napier therefore acts as the 'pull' in push-pull

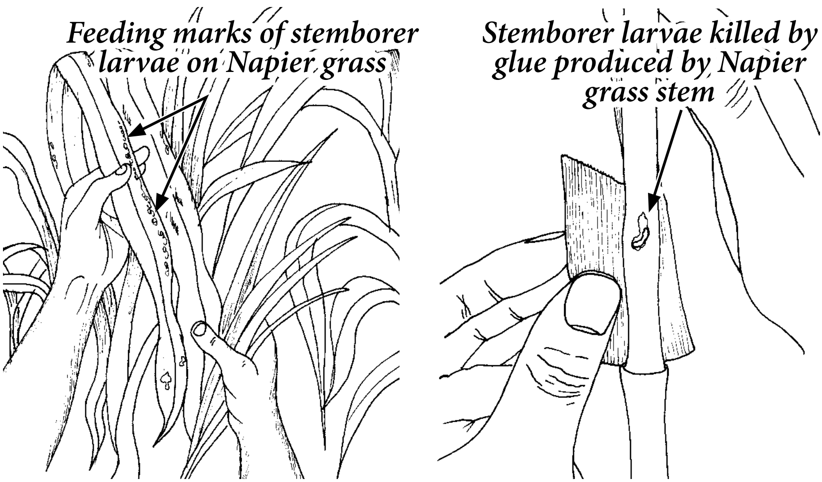


Figure 10. Napier leaves attacked by stemborer larvae (a). The larvae are killed by the sticky substance produced from Napier grass (b).

Benefits of adopting a push-pull strategy

When you adopt the push-pull strategy you will:

- Increase maize yield by 25-30% -in the areas where stemborers are the only problem. Where both stemborers and striga are problems, you can double your maize yields.
- Increase the supply of cattle feed from harvesting Napier grass and desmodium.
- Fix nitrogen into your farm soil by desmodium legume, so you save on fertiliser costs.
- Protect soil from erosion, as desmodium acts as a cover crop.
- Retain soil moisture, as desmodium acts as a mulch.
- Earn money from the sale of desmodium seed at an attractive price of between Kshs 600 and 800 (US$ 8 to 10) per kg.
- Make more money from increased milk production and sales.
- Save on farm labour, as you do not have to manually remove striga weed from the farm.
- Protect maize from strong winds, by surrounding it with Napier grass.

How To Establish A Push-pull Plot

Step 1. Land preparation

- Clear your land during the dry season.
- Plough and harrow your land to a fine tilth (until the soil has no large lumps) *before* the onset of the rains.
- Desmodium has very small seeds; therefore the soil should be carefully prepared so that it is as fine and clean as possible.
- Measure out your push-pull plot to a maximum size of 50 by 50 m (Figure 11).
- If you wish to layout a push-pull plot on land that is larger than 50 by 50 m, then measure out those pieces of land into plots of maximum 50 x 50 m size.
- If your land is less than 50 by 50 m, the pushpull technology will still work; however, do not plant push-pull in plots less than 10 by 10 m as the Napier grass will have a shading effect on the maize crop.

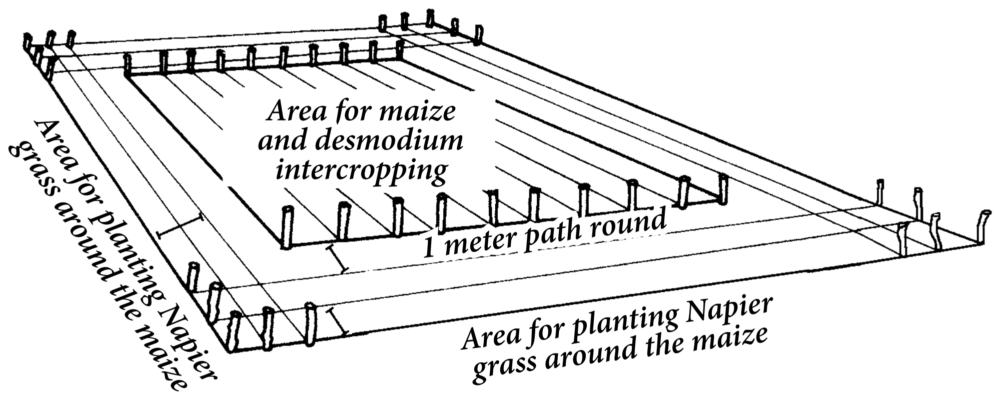


Figure 11. Layout of a push-pull plot

Step 2. Planting material

Ensure that you have all the needed planting material:

- Maize seed
- Desmodium seed
- Napier grass root splits or canes (Figure 12). The Bana variety is recommended. Ensure that the plot from which you are getting the planting material is not infected with Napier grass diseases (Figure 13)
- Triple superphosphate or single superphosphate fertiliser or farmyard manure.

Sources of planting material

- ***Napier grass:*** KARI centres, Ministry of Agriculture, Ministry of Livestock and Fisheries Development, other farmers.
- ***Desmodium:*** Western Seed Company Ltd., Kitale, Kenya.
- ***Maize:*** Seed companies, Kenya Farmers Association (KFA) and appointed stockists.

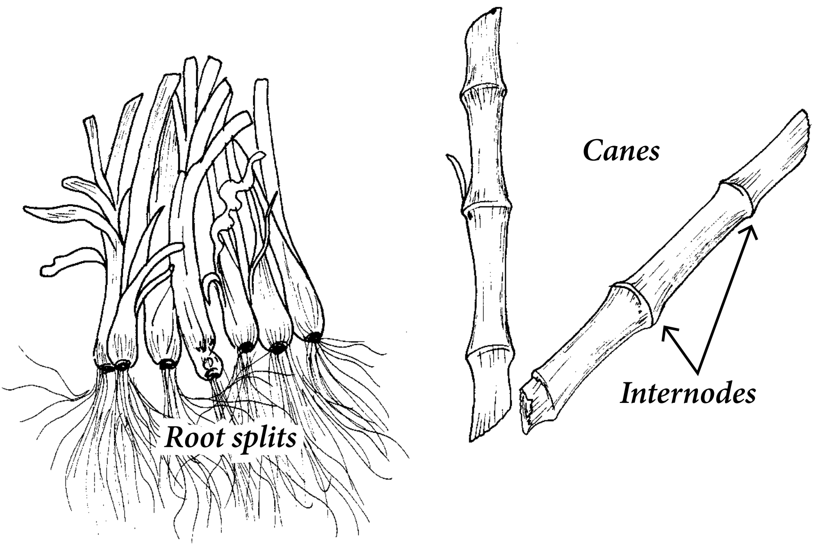


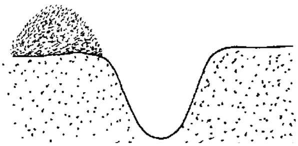
Figure 12. Clean Napier grass root splits and cane cut into nodes for planting

Figure 13. Diseased Napier grass plants are yellowish, stunted plants with short internodes. The leaves are very narrow. The disease is carried by a micoorganism (phytoplasma) and is transmitted by an insect, which is not yet known

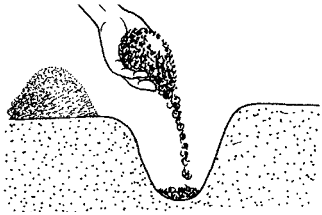
Step 3. Planting the push-pull crops

Planting Napier grass

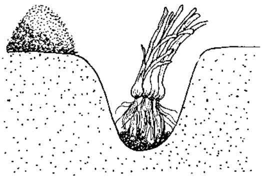
- Plant Napier grass (Bana variety is the best) in a border around the maize plot as shown in Figures 11 and 15.
- Plant at least three rows of Napier all round the maize field. The spacing should be 75 cm between rows and 50 cm between Napier grass plants within a row (Figure 14).



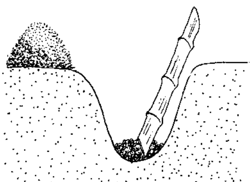
Hole ready for planting



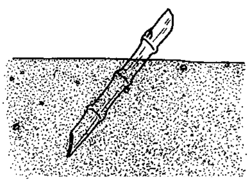
Put in one teaspoonful of TSP fertiliser or two handfuls of farmyard manure



Planting Splits



Place cane in the hole



Cover cane with soil after planting

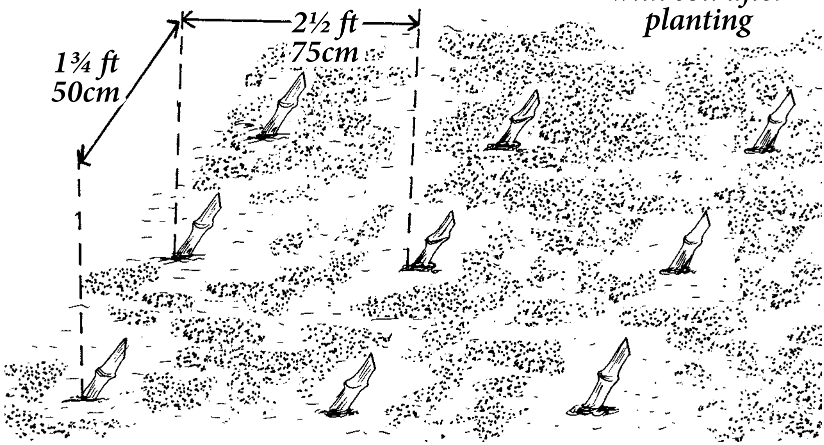


Figure 14. Newly planted Napier grass field

- Apply one teaspoonful of triple superphosphate (TSP) fertiliser or two handfuls of well decomposed farmyard manure in each hole before planting Napier grass (Figure 14).
- Place a three-node cane into the ground, ensuring that two of the nodes are covered, or place the root splits into the planting holes and cover with soil (Figure 14).
- In the first year, plant Napier grass before the rains so that it has a start on the maize. The stemborer moths will like the larger Napier grass for laying their eggs even more than the maize.

Planting maize

- Plant your maize in the field already surrounded by Napier grass.
- Ensure that the 1st row of maize is 1 m away from the inner row of Napier grass.
- The recommended spacing for maize is 75 cm between rows and 30 cm between hills in a row.
- Apply one teaspoonful of triple superphosphate or two teaspoonfuls of single superphosphate per hole.
- Plant two maize seeds per hole and then thin to one plant per hill after the first weeding.
- ***Note:*** Napier rows should be planted so that they alternate with maize rows (Napier should not be planted in the same row with maize), so that ploughing of the field in the next season will be easy (Figure 15).

Figure 15. Diagram of maize and Napier grass not planted in the same rows

How to intercrop desmodium

- You will need 1 kg of desmodium seed for 1 acre (0.4 ha) of land.
- Desmodium is drilled in between the maize rows so that the distance between the maize rows and desmodium rows is 75 cm. Maize is planted first, followed by desmodium.
- Using a strong pointed stick, make a furrow 1-2 cm deep in the middle of the space between the rows of maize or in the space where the maize will be planted (Figure 16).
- Mix the desmodium with superphosphate fertiliser (about one handful of seed and two handfuls of fertiliser). If you cannot afford fertiliser, then mix seed with fine sand (Figure 17).
- Sow the seed-sand or seed-fertiliser mixture into the furrows you have made and cover lightly with a small amount of soil (Figure 18).
- A single row of desmodium should also be drilled on all sides of the outer rows of maize at an inter-row spacing of 37.5 cm between the outermost maize row and the outer desmodium row.

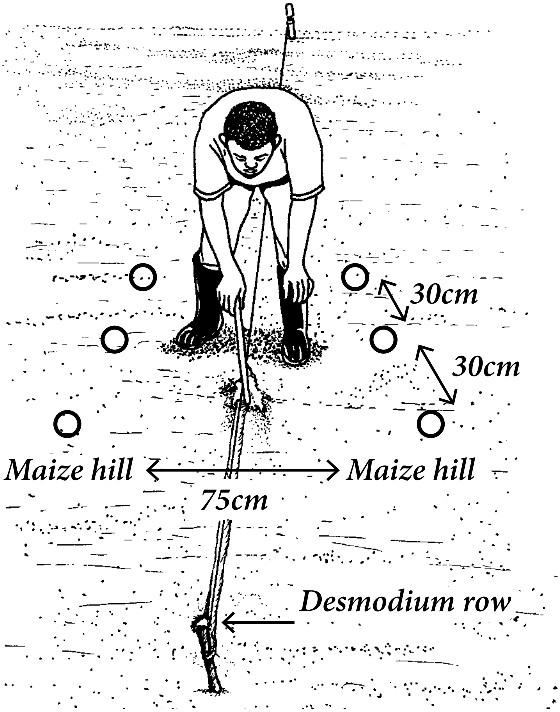


Figure 16. A farmer making rows for drilling desmodium seeds

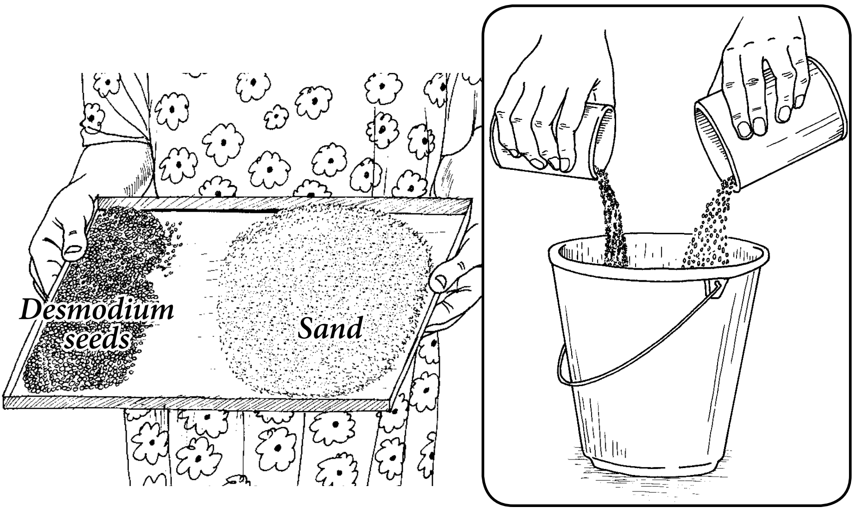


Figure 17. A farmer mixing desmodium seed with dry soil or sand for drilling. Use the ratio of 1 part seed to 3 parts sand

Figure 18. Farmers drilling and covering the desmodium seeds

- Plant desmodium with the rains for maximum germination.
- In areas where striga weed is NOT a problem, farmers can plant desmodium after every 3 or 5 rows of maize, and use the other rows to plant beans. Stemborers will still be kept away from the maize.
- In case you do not find desmodium seed, then you can use desmodium root splits or cuttings from any neighbouring farm. Planting of the splits or cuttings should be done when there is enough soil moisture to ensure good establishment.
- To make a desmodium cutting, cut the stem of the mother plant so that it has at least two internodes.

Step 4. Weeding

1st weeding and crop management

- Early weeding is very important for the successful establishment of a push-pull plot.
- The first weeding should be carried out when the maize is 3 weeks old.
- It is important to know the difference between desmodium and weeds. If in doubt, consult the nearest extension staff. Figures 19 and 20 show young desmodium plants.
- Care should be taken when weeding the drilled desmodium line. Hand picking of weeds in the line is recommended at this stage (Figure 21).
- Thin maize to one plant per hill.
- In striga-infested areas, apply nitrogen fertilizer (CAN) to the maize at the rate of one teaspoonful per plant (Figure 22) after the first weeding.
- Napier grass rows should also be weeded.

Figure 19. One-week-old silverleaf desmodium (left) and greenleaf desmodium (right) plants

FIgure 20. Three-week-old silverleaf desmodium (left) and greenleaf desmodium (right) plants

FIgure 21. Hand weeding desmodium rows and weeding the space betweenmaize and desmodium with a hoe

FIgure 22. A push-pull plot after the first weeding

2nd weeding

- The second weeding should be done when the maize is 5 weeks old (Figure 23).
- Care should be taken again to distinguish between desmodium and weeds (Figure 24).
- Napier grass rows should also be weeded again.
- Top-dress the maize and Napier grass with CAN fertiliser at the rate of one teaspoonful per plant.

Figure 23. Push-pull plot after second weeding

Figure 24. Five-week-old silverleaf desmodium (left) and greenleaf desmodium (right) plants

Step 5. Management of Napier grass

- You can start harvesting Napier grass when it is 3 months old or 1-1.5 metres high after planting (Figure 25).
- Start with the inner row nearest the maize and harvest this row around the field first. Leave a stem height of 4 inches (10 cm) from the ground at harvesting to encourage it to re-grow quickly (Figure 26).
- Feed this to your livestock. One dairy cow requires about 50-70 kg of green Napier grass per day.
- Always chop the fresh harvested Napier grass and desmodium to reduce wastage while feeding it to the livestock.

Figure 25. Farmers start harvesting Napier grass when it is 3 months old

Figure 26. Cutting of the inner row of Napier grass while leaving the two outer rows

- After the first forage has been harvested from the inner row, you can start harvesting the second row. This gives time for the inner row to grow again.
- The third row should be harvested only when the inner row is again 1-1.5 m high. This will ensure that there is always Napier grass of approximately 1-1.5 m high to trap the stem borers.
- The inner row can be harvested again when it reaches 1-1.5 m high, which means a period of 6-8 weeks between cuts.

Step 6. Harvesting of maize

- Harvest the maize once it attains maturity.
- Maize stover (stalks) left over after crop harvest can be used as livestock feed, particularly during the dry season. Always store the maize stover in a dry place to minimise spoilage.

Step 7. Management of desmodium

- After harvesting your maize crop, desmodium can either be harvested as forage for livestock (Figure 27), or Left to produce seed before it is harvested for forage (Figure 28).

Figure 27. Harvesting desmodium forage after harvesting maize from the field

Figure 28. Flowering/podding desmodium after harvesting maize

Harvesting desmodium for forage

- When harvesting for forage, always cut the desmodium vines so as to leave a stubble height of 6 cm above the ground to encourage re-growth.
- Chop the harvested desmodium and mix with Napier grass to reduce the wastage when feeding it to livestock.
- When forage is in short supply, particularly during the dry season, chop the desmodium, Napier grass and maize stover and mix them before feeding to your livestock.
- Caution: Never bring your livestock to graze in a push-pull field as they will destroy the desmodium.

Leaving desmodium for seed production

- If your desmodium is flowering and podding, you may leave it for seed production.
- After harvesting the seed, you can harvest desmodium forage for livestock feed.
- A farmer can get between 600-800 kg of green forage from a l-acre (0.4 ha) push-pull plot.
- In areas were the dry season is not severe, only cut enough desmodium needed for your livestock each day. However in areas where the dry season is severe or long, cut the whole field and make hay. Consult your agricultural extension officer on how to make good quality hay.

Step 8. Harvesting and processing desmodium seed

- When and how to harvest the seed:
  - Harvest the seed weekly once the pods have turned brown. Hand-strip (Figure 29) the ripe pods and place seeds in a tin.
  - Sun-dry and then thresh the desmodium pods using a stone and an old rubber shoe sole (Figures 30 and 31).
  - Winnow to get clean seed (Figure 32).
  - Store in dry, clean tin or airtight container (Figure 33).
- One acre (0.4 ha) of well managed and properly harvested desmodium seed crop can yield 50-60 kg of seed. This can earn a farmer between Kshs 30,000 to 50,000 (US$ 400 to 670) when sold at the current market price of Kshs 600 to 800 per kg of seed.

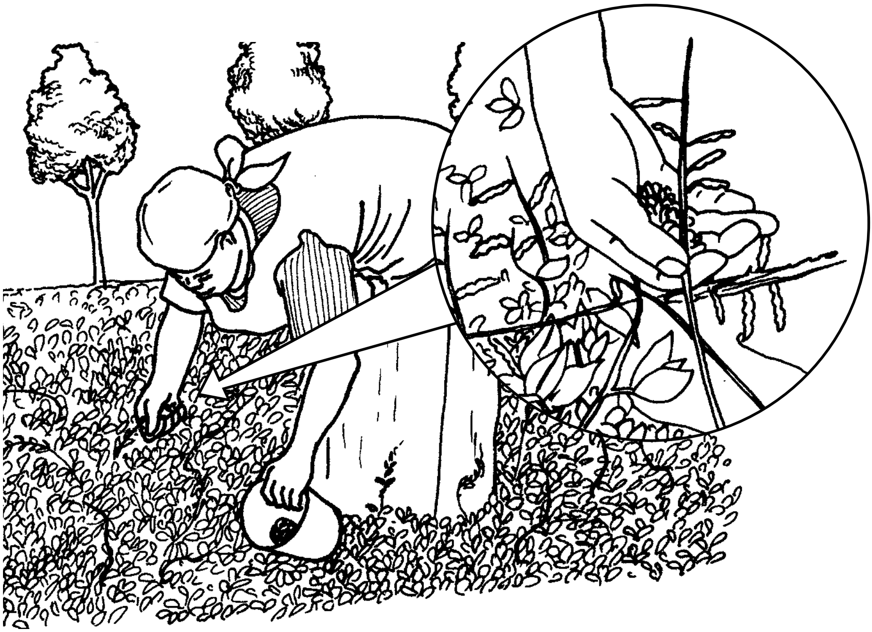


Figure 29. Harvesting of desmodium pods

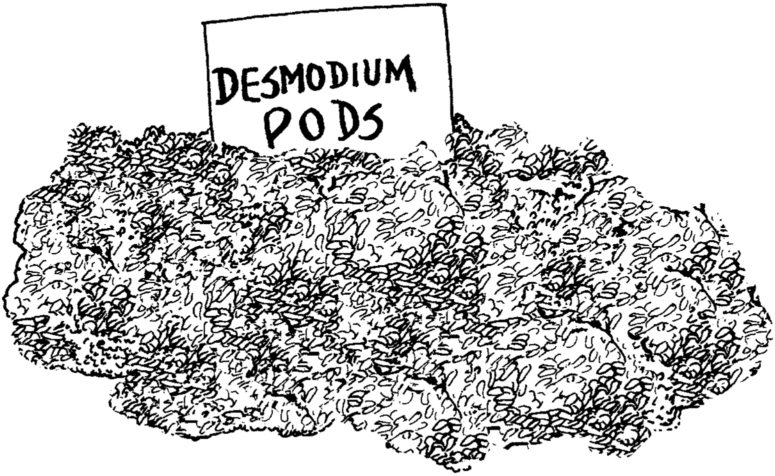


Figure 30. Sun drying of desmodium seeds

Figure 31. Threshing of desmodium seeds on a stone using an old slipper

Figure 32. Winnowing desmodium seeds

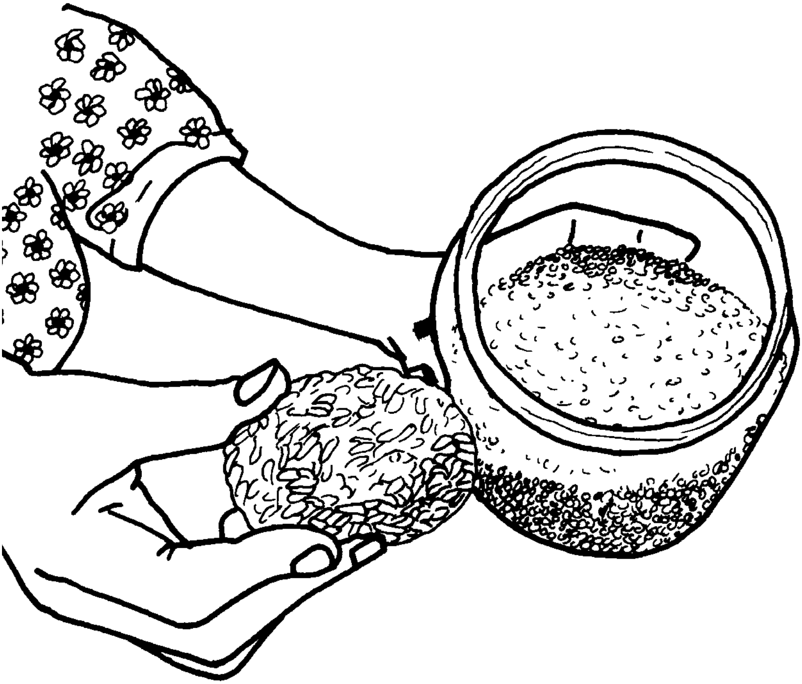


Figure 33. Store desmodium seed in a clean tin or airtight container

- In areas where moles and rats (rodents) are a problem, after the first season's harvesting, cut all the desmodium and Napier after harvesting the maize and feed to your livestock.

Planting Push-Pull During the Second and Subsequent Seasons

Step 1. Land preparation

- Continue cutting and utilising Napier grass, starting with the inner row as before and weeding the cut Napier lines.
- Apply farmyard manure or CAN fertiliser after cutting and weeding.
- Cut back the desmodium and feed to livestock. . Clear the land of maize stover and feed to livestock.
- Before planting maize, dig or plough between the rows of desmodium. Care should be taken not to disturb / uproot the desmodium lines as desmodium is a perennial crop (Figure 34).

Figure 34. Push-pull plot ready for planting maize during the second season

Step 2. Planting the second crop of push-pull

- Plant maize in between desmodium rows at a spacing of 75 x 30 em (Figure 35).
- Apply TSP or DAP fertiliser on the maize at the rate of one teaspoonful per hill as top dressing.

Figure 35. Newly planted push-pull plot during the second season

Step 3. Weeding

1st weeding

- Weed the maize when it is 3 weeks old. Napier grass and desmodium should also be weeded at this time.
- Desmodium at this stage can smother maize if not trimmed. It is recommended that you trim it when the maize is 3 weeks old.
- Thin maize to one plant per hill.
- In striga-infested areas, top-dress the maize with CAN fertiliser at the rate of one teaspoonful per hill.

2nd weeding

- The second weeding should be done when the maize is 5-6 weeks old.
- Desmodium should be trimmed again at this stage.
- Top-dress the maize with CAN fertiliser at a rate of one teaspoonful per hill.

4. Management of Napier grass

- Continue harvesting Napier grass for your livestock 6-8 weeks after the onset of the rains.
- Start cutting the inner row, followed by the middle row, then the outer row.
- Always maintain a 1-metre high row of Napier grass surrounding the tender maize, and be sure to give time for the previously cut row to grow before cutting the next.
- Caution: Leaving maize without a Napier grass border or row of 1-metre high will encourage stemborers to attack your maize.

Step 5. Management of desmodium

- After the second trimming (5-6 weeks after planting maize), leave the desmodium to grow until the maize is harvested.
- The rest of the management practices are similar to those for the first season.
- If you follow a good management regime for Napier grass and desmodium, you could benefit from your push-pull plot for 5 or more years.

Feeding Your Cow

- Chop the harvested Napier grass and desmodium to reduce wastage while feeding it to your cow (Figure 36).
- During the dry season, chop the maize stover into small pieces and mix with the chopped Napier grass and desmodium.
- Napier grass mixed with desmodium in the ratio of 3:1 is recommended for higher milk production of your cows and goats (Figures 37, 38).
- Two acres (0.8 ha) of a well managed push-pull plot can give enough Napier grass and desmodium for one dairy cow for one year, if supplemented with maize stover or other feeds during the dry season.
- Always remember to give your cow the recommended mineral supplements.

Figure 36. Chopping Napier and desmodium forage for feeding cows and goats

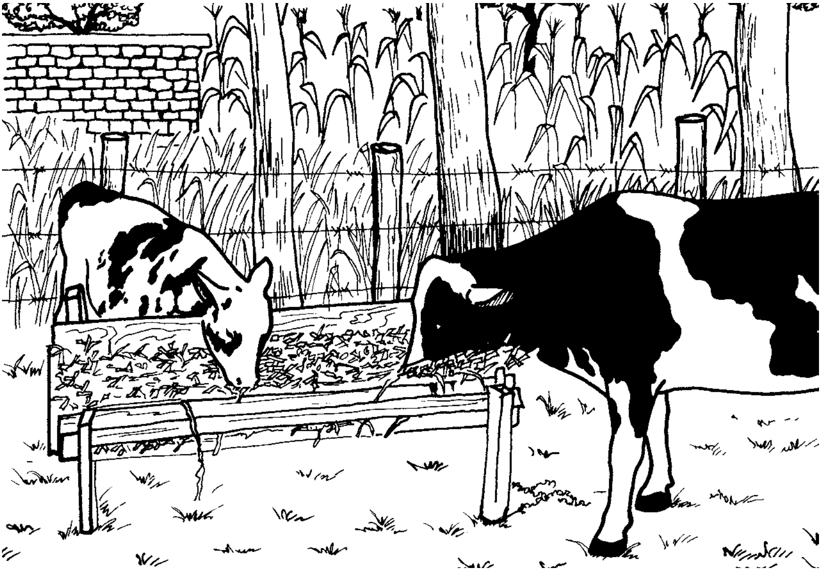


Figure 37. Cows feeding on chopped Napier mixed with desmodium forage. Mixing the small-leaved desmodium with Napier reduces wastage of the former

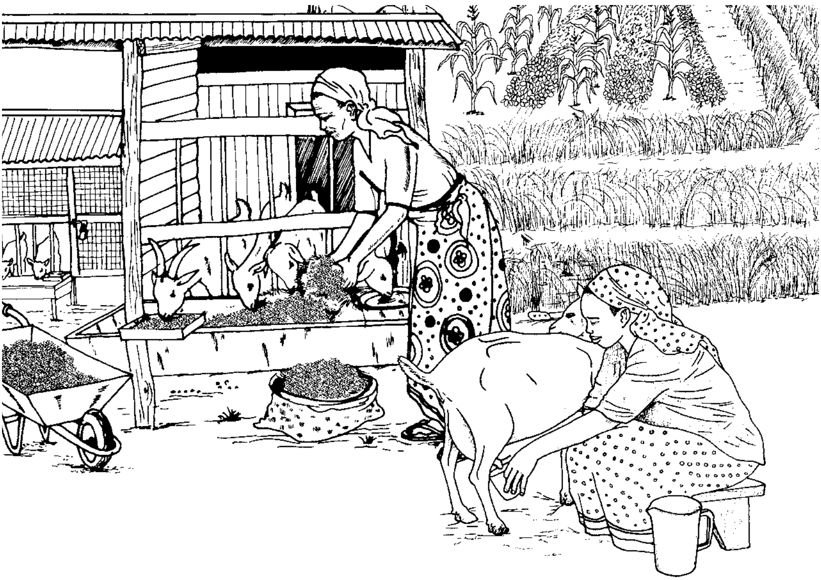


Figure 38. Dairy goats with chopped Napier mixed with desmodium in a trough

Things Not To Do

1. Do not trim desmodium during the first season.

2. Do not graze livestock in the push-pull plot, because animals will destroy the Napier grass and desmodium.

3. Do not intercrop desmodium with Napier grass in the same row.

4. Do not plant any other crop with the Napier grass.

5. Do not allow desmodium to spread into the maize rows in the second and subsequent seasons until the maize is 6 weeks old. This reduces the competition between the two crops.

6. Never cut all the three rows of Napier together. This avoids 'windowing'. Always cut one row all around your maize at a time.

7. Do not let Napier grass over-grow because it will not be effective in controlling stemborers and will become hard and coarse for cattle to feed on.

8. Do not plough under the desmodium rows. Replanting the desmodium is very expensive and is not necessary as it can grow for up to 5 years or more.

Frequently Asked Questions

Q1. What is the maximum and minimum size of the push-pull plot?

Answer:

A push-pull plot can range from 50 x 50 m (minimum) or be used on any size farm provided the fields are demarcated into 50 x 50 m sections using border rows of Napier grass.

Q2. What is the minimum width of a push-pull plot?

Answer:

Not less than 10 metres (32 ft).

Q3. How long can the push-pull plot be kept?

Answer:

If well managed, you can benefit from your pushpull plot for 5 or more years.

Q4. Can I graze my cattle directly in the pushpull plot?

Answer:

No. Grazing destroys desmodium and Napier grass.

Q5. Can I practise push-pull' if I don't have livestock?

Answer:

Yes, because you can sell the Napier and desmodium forage and seed to your neighbours and desmodium can improve the fertility of your soil.

Q6. Can I intercrop other crops and trees in the push-pull plot?

Answer:

Farmers can plant beans in the same hole with maize or in between maize plants in maize rows.

Q7. Are there alternatives to Napier grass and desmodium?

Answer:

Yes. Forage sorghums such as Sudan grass (Sorghum vulgare sudanense) can be used to trap stemborers instead of Napier grass. Molasses grass (Melinis minutiflora) can be used to repel stemborers instead of desmodium. Molasses grass does not control striga weed, however.

Q8. How long can desmodium survive in a prolonged drought?

Answer:

Desmodium can always regenerate after a drought. However you are advised to plough and re-establish a push-pull plot in case of a very prolonged drought or when desmodium fails to regenerate.

Q9. Can I plant maize first, then Napier grass after a few weeks?

Answer:

No. You are advised to plant Napier grass before planting maize, or if planting late, plant both crops at the same time.

Q10. When do I start reaping the benefits of the push-pull plot?

Answer:

You can reap benefits during the second cropping season in areas where farmers plant maize twice in a year, and during the second year in areas where farmers plant only once in a year.

Q11. Can I use push-pull on sorghum?

Answer:

Yes. Intercrop green leaf desmodium (Desmodium intortum) with sorghum to repel stemborers and control striga weed.

Q12. Is push-pull effective against other weeds and insect pests?

Answer:

Desmodium in the push-pull strategy can reduce other weeds by smothering them, but both Napier grass and desmodium may not reduce other insect pests. This technology is most effective against stemborers and striga weed.

Q13. Where can I obtain Napier grass and desmodium seeds?

Answer:

Napier grass can be obtained from neighbouring farmers. Desmodium seed is sold by Western Seed Company Ltd., Kitale, Kenya.

Q14. What can I do if I don't get desmodium seeds?

Answer:

Use desmodium root splits or cuttings from your neighbour. However ensure that you plant them immediately and when there is adequate soil moisture.

Q15. How effective is push-pull against stemborers and striga weed?

Answer:

Push-pull is very effective. It is even better than insecticides for the control of stemborers and better than manual removal of striga weed, both in terms of cost and labour. Push-pull is the most effective control.

Q16. Can I be given a dairy animal if I establish a push-pull plot?

Answer:

No. But you can qualify for applying to various projects on dairy animals.

Q17. If I don't have desmodium seed, can I plant only Napier grass in my push-pull plot?

Answer:

Yes. If you plant only Napier grass, you will be able to reduce stemborers on maize, but you will not be able to control striga weed. However, using both Napier and desmodium gives the best results.

Q18. Can the push-pull technology work in all parts of Kenya or Africa?

Answer:

Yes, but only in areas recommended for growing desmodium. Consult your agricultural extension staff.

Q19. Can I use other varieties of Napier grass other than Bana grass?

Answer:

Yes. You can plant Clone 13 Napier grass, French Cameroon, Kakamega 1, Kakamega 2 or Kakamega 3. But they are not as good a trap plant as the Bana grass variety.

Q20. Can I use other species of desmodium other than silverleaf?

Answer:

Yes. You can use greenleaf desmodium (Desmodium intortum). But the results with silverleaf Desmodium uncinatum) intercropped with maize are the best. Greenleaf desmodium can be used in drier areas.

Glossary

CAN	calcium ammonium nitrate
DAP	diammonium phosphate
deadheart	destruction of the growing bud in the plant whorl can result in a 'deadheart' -drying, stunting, and complete loss of yield by a plant
drilling in	to sow seeds in a furrow or trench in rows
emergence	the process of emergence of a plant from seed
ft	feet
greenleaf	greenleaf desmodium (*Desmodium intortum*)
host	an animal or a plant that maintains the parasite
indigenous	a plant or animal originating (native to) in an area
infestation (of striga)	penetration of germinating seeds of striga into the host root
internodes (for Napier or desmodium)	part of stem between two nodes
larva (pl. larvae)	newly hatched worm-like forms of insects which feed on plants
leafsheath	the basal or lower part of the leaf enclosing the stem
lodging	damaged plants due to heavy winds
m	metres
manual	by hand
molasses grass	*Melinis minutiflora*
node	an enlarged point on a stem where a leaf, bud, or other organ is attached

parasite	a plant or an animal that grows, feeds and is sheltered on or in a different plant or animal called the 'host'
pupa (pl. pupae)	inactive stage in the life cycle of stemborers, following the larval stage
silverleaf	silverleaf desmodium, *Desmodium uncinatum*
stover	dried stalks and leaves- of a cereal crop used as a fodder after grain has been harvested
top-dressing	applying fertiliser to the surface of the soil
TSP	triple superphosphate (fertiliser)
witchweed	parasitic weed such as *Striga hermonthica*

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District Agricultural Officers

This easy-to-read primer shows farmers how to manage two of the major pests of maize-stem borers and striga weed-in the eastern and southern Africa region without the useof chemical pesticides. The 'push-pull' strategy is a novel system of intercropping designed to manage the agroecohabitat for higher maize yields, while at the same time providing fodder, enriching the soil and conserving boidiversity

Push-pull can also be adapted for sorghum and millet fields and is an affordable, appropriate and socially acceptable technology for use by Africa's farmers.

icipe
African Insect Science for Food and Health

ROTHAMSTED RESEARCH

KARI

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