# INTEGRATED PEST MANAGEMENT FOR N2AFRICA LEGUME CROPS

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# Contents

# Introduction

There are many steps to "good crop management" which are important to all N2Africa crops grown in southern Africa. Many of these are simple practices and techniques which work for nearly all crops, including maize, sweet potato and other crops commonly grown during the rainy season. Some start before the crop has even been planted, for example site selection and land preparation. Others are most important in the earlier stages of crop production, such as weeding. And others are important throughout the growing season, such as removal of plants infected with diseases which can spread to other plants, leave germs in the soil to infect next season's crops, and so on.

# The First Step: Healthy Crops

Just as with children, it is important to look after young plants so that they are more resistant to diseases and other pests, and grow into strong "adults" who can "bear many children" (have high yields of grain). Some simple steps to follow are:

- **Use good seed:** A strong, healthy seed is more likely to grow into a strong, healthy plant. Seed which has been grown and stored under good conditions has a better chance of germinating and growing well – this is why it is important to use selected, quality or certified seed. In addition, there are several diseases which can be carried in/on the seed…infecting the new crop shortly after germination. Two examples are Common Bean Blight and cowpea viruses (discussed below).
- **Rotate the land where the crop is grown:** it is better to grow a legume crop on land that was planted to a cereal like maize, or any other non-legume crop (sweet potato, cassava, Irish potato) the previous rainy season. This is because there will be less chance that pests and diseases attacking legumes will be remaining in the soil from the previous crop. Just as a baby is weak against diseases, young crop plants are very easily infected, stunted or worse (killed) if attacked by pests and diseases when they are small.
- **Plant the crop at the right time:** planting on time helps to prevent the crop from being hit by drought before it has matured, which means the yield is more likely to be good. Planting with the first good rains also means the crop will grow quickly and be strong when pest and disease problems arise, as is the case for bean stem maggot (discussed below). Also, some pests and diseases don't have an impact on crop yield if they attack the crop when it is nearing maturity, as is the case for soybean rust (discussed below). There are many good reasons to plant on time…rather than waiting to plant the legume crops AFTER all the maize has been planted.
- **Plant the crop in the right type of soil:** groundnuts do not grow well in soils which remain wet for long periods of time (heavy clay soils), whereas soybeans do better in soils which hold water better (soils with some clay).
- **Add organic matter to the soil before planting:** there are many reasons why adding compost, manure and other types of organic matter will help the crop to grow better. Organic matter improves the soil structure so it holds more water (if sandy) or drains better and is easier for roots to grown in (if heavy). Organic matter contains many nutrients to feed the crop; it also contains what are known as "beneficial organisms" which actually attack the "bad organisms" which cause many pests and diseases. These usually cannot be seen with the human eye alone…but they are there!
- **Keep the field free from weeds:** Weeds should be removed from the land prior to sowing the seed, and at regular intervals until the crop has grown so tall that the leaves shade the soil (which makes it difficult for weeds to grow). Weeds are bad for many reasons: they "steal" soil nutrients and water from the crop plants, if they are taller than the crop plants they block the sun, which crop plants need to grow. The can also sometimes serve as "hosts" for bad insect pests or crop diseases. A hoe can be used for weeding when the plants are small, but as they grow larger, it is better to remove weeds by hand since the hoe – which is large – can easily damage the crop plants.
- **Remove and destroyed sick plants:** A sick plant left in the field produces many germs, which go on to infect healthy plants. Crops should be visited and examined regularly so that sick plants can be uprooted, removed from the field and destroyed in a place far from the crop, by a means such a burying which prevents the germs from escaping.

## Management of General Insect pests

There are some insect pests which can attack all the N2Africa legume crops. But it is very important that these pests are clearly identified before any action is taken! Not only does the farmer risk applying the "wrong" treatment if s/he does not truly know which pest is attacking the crop….but there are many "good" insects farmers will see in the crop that they should not kill. These "good" insects are called "beneficial insects" – they feed on or otherwise kill many bad insects which cause damage to the crop. More information about these good insects is given in these guidelines. A brief summary of some of the insect pests which may attack all/more than one legume crops:

### Aphids:

Aphids are small insects which attack legumes and feed on them by sucking away the plant's juices. This weakens the plant, even to the point of death in the case of young plants, which they tend to attack on the stem (see photo 1 below). Aphids can also disturb the growth of the leaves, causing them to develop strange shapes and become smaller (see photo 2 below). Often ants will be found in aphid infected plants, because they gather the plant juice from the aphids; the ants themselves do no damage to the crop, however. Aphids also cause a "hidden" damage to legume crops by carrying diseases (mainly viruses) which then infect the plant, the same way a needle used on an HIV infected person can transmit the virus if used on a healthy, uninfected person. Many of these diseases – like HIV – are very dangerous and can destroy a crop entirely. There is, however, a "good insect" which attacks aphids, called a ladybird beetle (photo 3). So farmers should be careful not to kill ladybird beetles when they find them in their fields.

**Photo 1. Aphids feeding on stem**

**Photo 2. Leaf damage caused by aphids**

**Photo 3. Adult ladybird beetle – a good insect which kills aphids**

## Bollworm:

The larva (young caterpillar) of bollworms attack a wide range of crops, including cotton as well as beans, cowpea and soybean. The young bollworms eat the flower buds and flowers pods, causing the flowers to drop. They also feed on the pods, leaving holes (photo 4) and causing the pods to wilt (photo 5) and damaging many of the seeds. Because they attack so many crop plants, bollworms are difficult t control. Avoid planting legumes close to fields of cotton, okra or tomato. Hand-pick the caterpillars off the plants and kill them. Because the bollworms are often inside the pods where insecticide sprays cannot reach them, spraying insecticides often does not work, and the ladybird beetle and other "good insects" can eat the eggs and very small caterpillarsof bollworm, so it is best not to spray chemical insecticides.

**Photo 4. Bollworms and holes in pod**

**Photo 5. Wilted pods**

## Leaf eating beetles:

These insects have shiny black/blue bodies and orange/yellow heads (photo 6). They eat the leaves of legume as well as many other crops such as okra. It is best to prevent beetle attacks by not planting legume crops in the same land every season, instead following the legumes with maize or sunflower (crop rotation). Plowing the land after harvesting the crop also helps as this exposes the insects which are sleeping in the soil to sunshine which can kill them. Applying Tephrosia sprays directly to the insects can also help to reduce the numbers of beetles.

**Photo 6. Adult leaf eating beetle**

## Bean stem fly:

The stem fly is most dangerous to young seedlings. The adult, which is a small black shiny fly, lays eggs in the leaf or stem tissue (Photo 7). The eggs hatch into small worms which move down the stem of the plant (photo 8) to the roots where they develop into "pupae". The resulting damage is death of the plant's main root (photo 9), followed by wilting and death of the seedling (photo 10). Bean seedlings are most susceptible to stem fly attacks, however cowpea, soybean and other legumes can also be attacked. Management of bean stem fly is best achieved by a combination of techniques:

- Add manure or compost to the soil before planting; well nourished seedlings are more resistant to stem fly attack
- Avoid planting legume crops in the same land season after season; rotate to maize or other non-legume crops
- Plant the crops early – the stem fly is most active after the peak of the rainy season so early sown crops are more likely to escape attack
- Earth up (building up) the soil around the plants to cover the roots at 2-3 weeks after emergence - this helps the plants to form new roots and if there is enough soil moisture, the plants are able to recover from the damage
- You can also apply a mulch of straw or other organic matter to encourages the plant to form new roots above the point of stem-fly damage

**Photo 7. Punctures in leaf from egg-laying by stem fly**

**Photo 8. Stem fly worms moving down through through stem towards roots**

**Photo 9. Roots killed by stem fly pupae**

**Photo 10. Bean seedlings shriveled and dying from stem fly Attack**

## Termite damage:

Under conditions of drought, all legumes can be attacked by termites – this is more likely to occur in red and sandy soils. The termites enter through the root system, unlike the stem fly, and then destroy the roots and inside of the stem. The symptoms are similar to steam fly attack in that the plants wilt and then die (photos 11 and 12), but if you split the stem of the dead plant open, you will see the damage starts from the bottom and moves upwards. Often holes or cracks in the soil, through which the termites enter and leave, can be seen around the dying/dead plants (photo 11). Putting a layer of Tephrosia leaves as a mulch on the soil around the legume crop helps to deter the termites from entering into the field.

**Photo 11. Soybean attacked by termites - note holes and cracks in soil**

**Photo 12. Groundnut attacked by termites**

## Use of Tephrosia vogelii to manage insect pests:

Tephrosia vogelii is a shrub with white or purple flowers, found growing in many parts of Malawi. A water extract can be made from the leaves of Tephrosia vogelii which will kill insects when sprayed directly on them. There is no "protective" effect of this spray, so it works only when it is applied directly to the insect; for insects hiding underneath the leaves, the spray must be directed to the underside of the leaves. Explanation of how to use Tephrosia is at the end of this document (Pages 14 - 15).

**Photo 13. Flowers of Tephrosia vogelii**

**Photo 14. Pods of Tephrosia vogelii**

## Nematodes:

Root-knot nematodes (which attack tobacco) can attack groundnuts, cowpea and beans. These nematodes cause roots (and pegs, in the case of groundnut) to become large, forming "galls", which differ from Rhizobium nodules in that the galls are internal swellings to the roots (photo 15) whereas nodules are attached to the side of the root (photo 16). The galls can also occur on the groundnut pods. As occurs in tobacco, groundnut, bean and cowpea plants severely attacked by nematodes have damaged root systems, and tend to wilt easily when dry spells occur. Plant growth above ground is stunted. The best way to manage nematodes in groundnut is a combination of techniques:

- Do not grow groundnut, beans or cowpea on the same land two seasons in a row, instead rotate to maize, sorghum or cotton to reduce the nematode presence in the soil
- Add organic matter (compost, manure) to the soil before planting the legume crops. This will change the soil environment to make it less favorable to nematodes. Also, soils with lots of organic matter tend to contain higher levels of "natural enemies" of nematodes: small, invisible organisms which attack and kill nematodes.

**Photo 15. Root knot nematode galls (plus nodules) on roots**

**Photo 16. Nodules attached to side of groundnut roots**

# Groundnut

## Rosette Virus:

Plants infected with rosette virus are very small (stunted – photo 17) and the leaves produced are progressively smaller, pale yellow and often curled . Infection of young plants results in very low yields (reduced number and size of pods). The disease is carried by aphids, who infect the plants with the virus when they feed on the plants (see above section on "Aphids"). The best way to manage rosette virus is prevention through a combination of techniques:

- Plant groundnuts early in the rainy season and at a high seeding rate
- Remove all infected plants from the field and destroy them (e.g. deep burying)
- Remove all "volunteer" groundnut plants which may appear in the field (these are plants growing from seed left over from the previous season)
- Look for aphids and when seen on the crop, kill with Tephrosia sprays
- Destroy all un-harvested infected plants

**Photo 17. Small (stunted) rosette infected groundnut between healthy, uninfected plants**

## Early and Late Leaf Spot:

Leaf spot is caused by a fungal disease, and is seen as dark brown or black round spots on leaves (photos 18 and 19) and other parts of the plant . Severe infections can result in the leaves dying and dropping from the plant . Leaf spot is extremely difficult to control once it has infected groundnut crops, and a combination of techniques to prevent leaf spot infected are recommended:

- Do not grow groundnuts on the same land more than once every three years; it preferable to rotate to maize or another non-legume crop. All "volunteer" groundnut plants which appear in the rotation crops should be uprooted and destroyed outside of the field.
- All crop residues should be buried deeply into the soil after harvest so that the disease germs are destroyed.
- Plant resistant varieties, whenever they are available
- Spray mancozeb or chlorothalonil according to label instructions

**Photo 18. Early leaf spot**

**Photo 19. Late leaf spot**

## Groundnut Rust:

Rust in groundnut caused by a fungal disease organism. It usually appears as orang-brown colored patches on the lower (under) side of the leaves (photo 20), and can also appear as dark streaks on the stem (photo 21). Unlike leaf spot infections, severe rust infections result in leaves drying up but remaining attached to the plant (rather than dropping). Note: groundnut rust is a different disease to soybean rust – the rust disease which attacks groundnut cannot attack soybean, and the rust disease of soybean cannot attack groundnut. Groundnut rust is managed by a combination of techniques:

- Do not plant the same land to groundnut from one year to the next; follow groundnut with maize, other cereals or even other legume crops
- Incorporate groundnut residues into the soil after harvest
- Remove any "volunteer" groundnut plant which may grow in the rotation crop
- Plant groundnuts with the first planting rains (late planted crops are more susceptible to rust)

**Photo 20. Groundnut rust on under (lower) side of leaf**

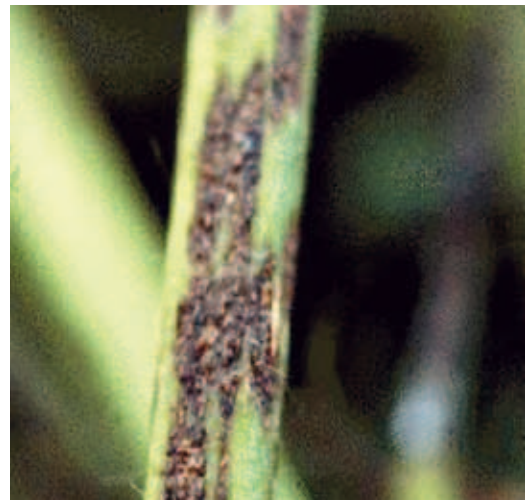

**Photo 21. Groundnut rust on stem**

## Web Blotch of Groundnut:

Web blotch of groundnut is caused by a fungus. It looks different from early and late leaf spot in that the marks it creates on leaves are not circular, but "irregular", and the marks do not show on the bottom side of the leaves until much later in the disease cycle than leaf spots. The spots appear as scattered tan colored specks on the upper leaf surface; these specks grow in size to become large, purplish to dark brown blotches (Photo 22). In severely affected plants, heavy defoliation can occur. Web blotch develops under cooler temperature conditions and requires longer periods where the leaves are wet compared to leaf spots. The disease is carried on groundnut crop residues and volunteer groundnut plants. The best way to manage web blotch is a combination of techniques, focusing on prevention:

- Do not plant the same land to groundnut from one year to the next; follow groundnut with maize, other cereals or root crops
- Compost or bury all groundnut residues, do not leave infected residues in the field exposed in the field
- Remove all plants with symptoms at the first signs of infection and remove all volunteer groundnut plants
- Do not grow Spanish groundnut varieties where the disease is known to occur as they are more suspectible

**Photo 22: Groundnut leaves attacked by web blotch**

# Soybean

## Soybean rust:

Rust disease of soybean, which is caused by a fungus, is not related to groundnut rust (in other words, a soybean crop growing next to a groundnut crop with rust will not be infected by the groundnut rust). The symptoms are, however, similar in that the disease is first seen as small yellow spots, mainly on the under-surface (back side) of the leaves; these spots grow and become orange to reddish brown in color (Photo 23). The spots can be found on all plant parts, but are most common on the under-side surface of the leaves (Photo 24). A soybean crop which is seriously infected by rust can lose its leaves. Soybean rust is best managed by a combination of techniques to prevent the disease from attacking the crop:

- Early planting of soybean helps the crop to escape from a serious rust attack
- Early maturing varieties of soybean also are more likely to escape a serious rust attack
- Planting resistant/tolerant varieties, if available (e.g. SeedCo's Squire)
- Spraying the crop with an effective fungicide (e.g. mancozeb)

**Photo 23. Soybean-rust infected leaves with lots of light-brown colored spots**

**Photo 24. Soybean rust spots on underside of leaf**

## Soybean bacterial pustule:

The first symptoms of bacterial pustule are very small pale green spots, which can appear on both sides of the leaves (photo 25). These spots become larger and reddish brown in color, but should not be confused with rust. The dark-colored areas of the leaves infected by bacterial pustule can be blown out by wind and rain, leaving holes in the leaf. This disease is best managed by a combination of preventative measures – there are no chemicals which can control bacterial pustule:

- Use good quality clean seed of a known origin (bacterial pustule can be carried in the seed)
- Do not plant soybean to the same land two seasons in a row
- Do not move from working in a wet, bacterial pustule infected crop to a clean, uninfected soybean crop, clean tools well before using them in another crop (the disease can be carried and spread by clothing, hands/feet and tools)

**Photo 25. Symptoms of bacterial pustule on soybean**

## Soybean Witches Broom:

This disease has only been found only in soybean and wild plant species to date. It causes the plants to develop very strange growth habit with very small leaves (photo 26). Very little is known about this disease, except that it is caused by a type of virus; should you see any plants with these symptoms, please contact a member of the N2Africa team as soon as possible.

**Photo 26. Soybean Witches Broom. Note very small leaves and strange growth of plants**

# Common Bean

## Common bacterial blight:

Infection of bean plants by bacterial blight is most common under warm, moist growing conditions. The symptoms are seen on the under-side of leaves, being initially very small "water-soaked" spots which turn into dark-brown patches surrounded by a narrow yellow margin (Photo 27). On the pods, symptoms are sunken, circular spots (photo 28) which later dry and turn brown (photo 29). The germs of the disease can infect the seed, so that when the seed is sown the following season, the disease quickly develops and spreads throughout the field. Management of bacterial blight is best achieved through a combination of techniques:

- Use good, disease free seed of a known source – no seed should be saved from a crop which has been infected by bacterial blight
- Do not plant beans on a field which was infected with bacterial blight for at least 3 seasons after the infection occurred
- Plow crop residue deeply into the soil so that the infected material will be destroyed
- Do not move through wet bean fields as the disease can be spread on clothing, hands and feet/shoes, and wet plants are more susceptible to infection than dry ones
- Plant resistant varieties, if available

**Photo 27. Bacterial blight on bean leaves**

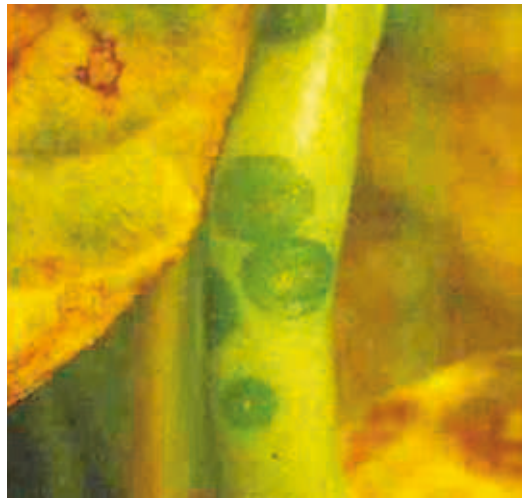

**Photo 28. New bacterial blight infection on immature bean pods**

**Photo 29. Older bacterial blight infection on bean pods.**

# Cowpea

## Cowpea mild mottle virus (CPMMV):

This virus, like groundnut rosette virus, is spread from one plant to another by white flies. Cowpea virus can also be carried in the seed from one crop to another. This virus can infect soybean and bambara groundnut, in addition to cowpea. The symptoms of CPMMV can be different with different cowpea varieties, but generally the infected plants will have a "mosaic" pattern in the leaves (photo 31). A combination of measures, with an emphasis on prevention, is the best way to manage cowpea virus:

- Use disease free seed of a known source; never plant seed produced by a crop which has shown symptoms of cowpea virus
- Plant cowpea crops early so that they mature before whitefly populations (which spread the diseases) have built up to high levels; intercropping with maize or sorghum can also reduce spread of cowpea virus
- Remove any "volunteer" cowpea plants from the field and destroy them; remove any plant showing symptoms of cowpea virus from the field and destroy it
- Prevent white fly populations from building up in the crop by use of Tephrosia spray to kill the white flies directly
- Bury all crop residue into the soil so that the virus germs will be destroyed before the next rainy season

**Photo 30. Cowpea plant with leaves showing symptoms of cowpea virus infection**

**Photo 31. Soybean infected by CPMMV virus**

## Cowpea flower thrips:

Thrips are very small insects which are difficult to see (just 1 mm long). They feed on flower buds and flowers, as well as the tip of the young plant. Attacked flower buds become brown and eventually fall off, leaving behind dark red scars. Damaged flowers are have strange shapes, are discolored may fall off. Pods which are attacked by thrips have scars and may be strangely shaped. Management of thrips is best achieved through a combination of techniques:

- Intercrop cowpeas with maize or sorghum
- The pupae or over-wintering phase of thrips lives in the soil. Plowing and harrowing the soil before planting helps to expose the thrips to sunlight, which kills them. During the cropping season, covering the soil with a mulch (straw, other dry organic matter) helps to be prevent the thrips from emerging from the soil, and beneficial insects and diseases which kill the thrips pupae to grow.
- Spray with Tephrosia, being sure to cover the flower. Thrips tend to fly off the plant when disturbed, so you can also spray them in the air above the plant.
- Use resistant varieties, when available

**Photo 32. Adult cowpea thrip (actual size 1 mm)**

## Alectra vogelii:

Alectra is a parasitic weed (similar to "witch-weed" in maize) that attaches to the roots of many legume crops, especially cowpea and groundnut. Sometimes it can be found in fields of soy bean, common bean, Bambara, mung bean and lab lab. In central Tanzania this weed also attacks sunflower. Not all these crops will be attacked everywhere that Alectra occurs, although cowpea is attacked throughout Africa. Alectra has bright yellow flowers and below the soil surface a distinctive thick, bright orange "root" that is attached to the root of the host plant. Alectra takes up some nutrients and water from the plants it attacks (Photo 32). Cowpeas tend to be stunted, sometimes look wilted and produce few pods.

Alectra is difficult to control because each plant produces thousands of seeds which are spread by wind
and rain; these seeds remain viable (alive) in the soil for 10-15 years. Crop rotation is therefore not
effective in reducing Alectra.

A combination of measures, with an emphasis on prevention, is the best way to manage Alectra.

- If just a few plants are seen it is worth up-rooting and destroying these to prevent further build-up of infestation, followed by destroying the uprooted plants before they produce any seed!
- Some cowpea varieties with resistance to Alectra exist, and are a good way to manage Alectra infestations. The Alectra resistant variety Mkanakaufiti was released in Malawi in 2011, and seed is available from Bunda College.

**Photo 33. A cowpea plant attacked by Alectra (note yellow flowers of Alectra)**

# TIPS ON HOW TO USE TEPHROSIA FOR PEST MANAGEMENT

Prepared by G. Sileshi, Entomologist and R. Katanga, Development Facilitator

## Introduction

Several species of *Tephrosia* have pesticidal properties. *Tephrosia vogelii* has been well studied, and it was widely used in pest control before the advent of DDT. *Tephrosia vogelii* has pea-like flowers, which may be white or purple, and velvety pods. *Tephrosia candida*, another species widely used in agroforestry, can be easily confused with *Tephrosia vogelii*.

Rotenone is the chemical responsible for the pesticidal property of *Tephrosia vogelii*. Rotenone, with an acute oral toxicity of 132-1500 mg/kg, is classified by WHO as a moderately hazardous or Class II pesticide.

**Tephrosia shrub**

The leaf extract of Tephrosia vogelii contains 80-90% of the rotenone in the plant. Rotenones are broad spectrum in action. So, the leaves can be used for control of pests in the field, in storage or on domestic animals. The advantage of Tephrosia is that, unlike most synthetic pesticides, it leaves no residue on crops as rotenone breakdown within 3-5 days after application.

## Control of field insects

When harvesting, only the leaves need to be taken off the shrub. If removed carefully, the shrub will continue to produce leaves for future use or for improving soil fertility. To extract the active ingredients, pound the fresh leaves in a mortar. The effective concentration is approximately 1 kilogram of leaves for every 5 litres of water. The crushing of leaves does not need to be done perfectly. After soaking for 2 hours or boiling it for 30 minutes, filter the juice through a cloth and use directly in the sprayer. Add a bit of soap to help the spray stick to the plant. This mixture can be sprayed on garden vegetables, fruits, field crops and nursery seedlings for control of different kinds of insects. It is important that the spray have contact with the pest. If the pest is underneath the leaves, be sure to actually hit the pests. This treatment is effective up to 7 days. After that time the process must be repeated.In areas of heavy termite infestation the leaf mulch can also be very helpful.

## Protection of stored grains

*Tephrosia vogelii* leaves may also be used for protection of stored cereals and legumes. Take the fresh leaves and dry them under the sun. Grind or pound the dried leaves into a powder. Mixing 100 grams of powder with 100 kg of maize or beans will protect grains from weevils, the larger grain borer or bean bruchids. This treatment is effective up to three months. After that time the process must be repeated. Thoroughly wash the *Tephrosia* powder off grains before using the maize or beans for food.

**Flowers of *Tephrosia vogelii***

## Protection of domestic animals

Pound the fresh leaves in a mortar and prepare the extract as described for control of field pests. Dilute this with five times that volume of water and wash the animal with the mixture. This treatment will effectively remove ticks lodged in animal fur. Rotenones are very toxic to pigs. So extreme care should be exercised when treating pigs.

## Precaution

Please note that *Tephrosia* is dangerous to fish, humans, domestic animals and wild life. Do not use *Tephrosia* to poison fish. Poisoning fish using this plant is illegal in Malawi! When using *Tephrosia*, try to keep the extract away from your skin or use gloves if available. Wash hands with soap as soon as you have finished applying it on crops or animals.

**Pods of *Tephrosia vogelii***

**Flowers and pods of *Tephrosia candida***

## Photo credits

The photographs in this document are from numerous different sources, as follows:

| | |
|---|---|
| Mhango, J. (IITA-Malawi) | Photos 1, 10 |
| Allen, D.J. et al., 1996 | Photos 2-9, 26-28 |
| Turner, A. (IITA-Malawi) | Photo 11-12, 17 |
| Sileshi, G and R. Katanga | Photos 13-14 |
| www.nespal.org | Photos 15 |
| Henriques Victor Colial (IITA-Mozambique) | Photo 16 |
| Subrahmanyam, P. et al., 1992 | Photos 18-21 |
| Njoroge, S. ( ICRISAT-Malawi) | Photo 22 |
| Bandyopadhyay, R. (IITA-Ibadan) | Photos 23-25 |
| Kumar, L. (IITA-Ibadan) | Photos 26, 31 |
| www.plantwise.org | Photos 29, 32 |
| Riches, C Natural Resources Institute University of Greenwich UK | Photo 33 |

N2Africa is a large scale, research and development project focused on putting nitrogen fixation to work for smallholder farmers growing legume crops in Africa. N2Africa is funded by 'The Bill & Melinda Gates Foundation' thorough a grant to Plant Production Systems, Wageningen University, in the Netherlands. It is led by Wageningen University together with CIAT - TSBF, IITA and has many partners in the Democratic Republic of Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe. At the end of the 4-year project we will have: identified niches for targeting nitrogen fixing legumes; tested multi-purpose legumes to provide food, animal feed, and improve soil fertility; promoted the adoption of improved legume varieties; supported the development of inoculum production capacity through collaboration with private sector partners; developed and strengthened capacity for legumes research and technology dissemination; and delivered improved varieties of legumes and inoculant technologies to more than 225,000 smallholder farmers through our Master Farmer Network.

**For more information on the project,**
**please visit our website at**
**http://www.n2africa.org/**

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