

# Using pesticidal plants in crop protection

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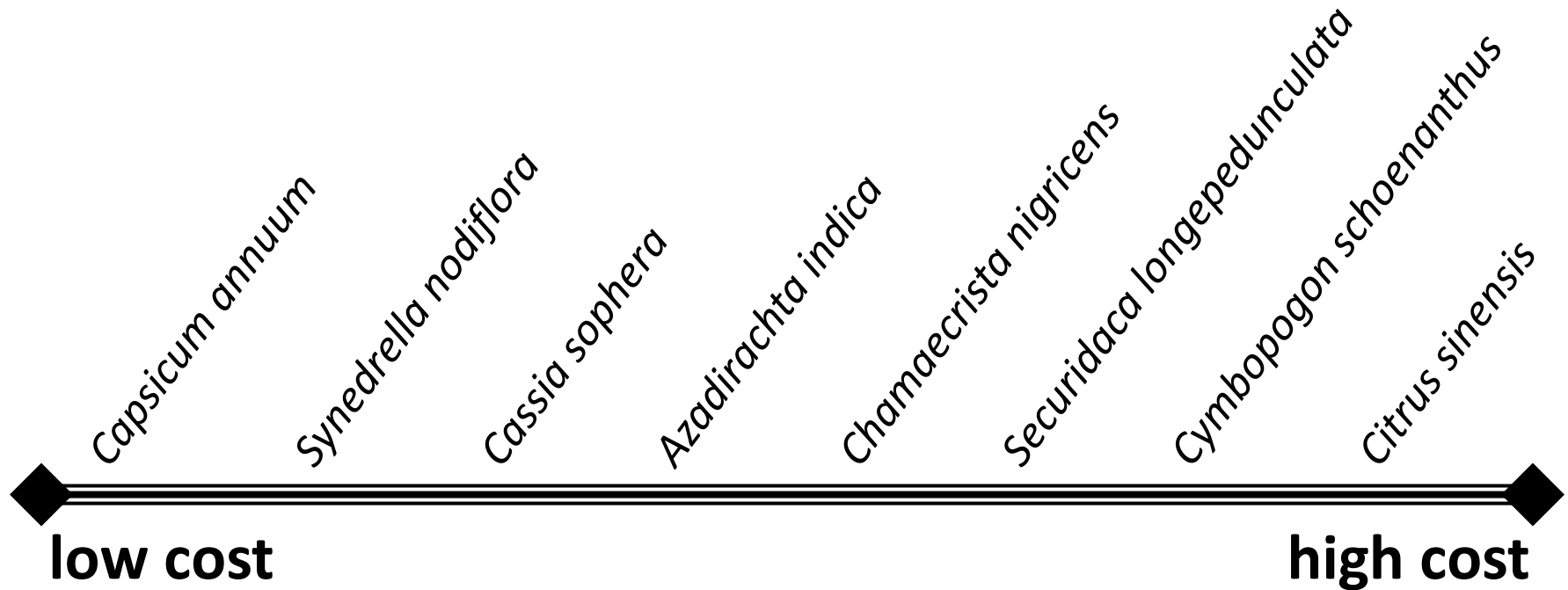
# Factors affecting plant material usage






Cost  
Effectiveness  
Availability  
Toxicity  
Ease of use  
Acceptability  
Versatility



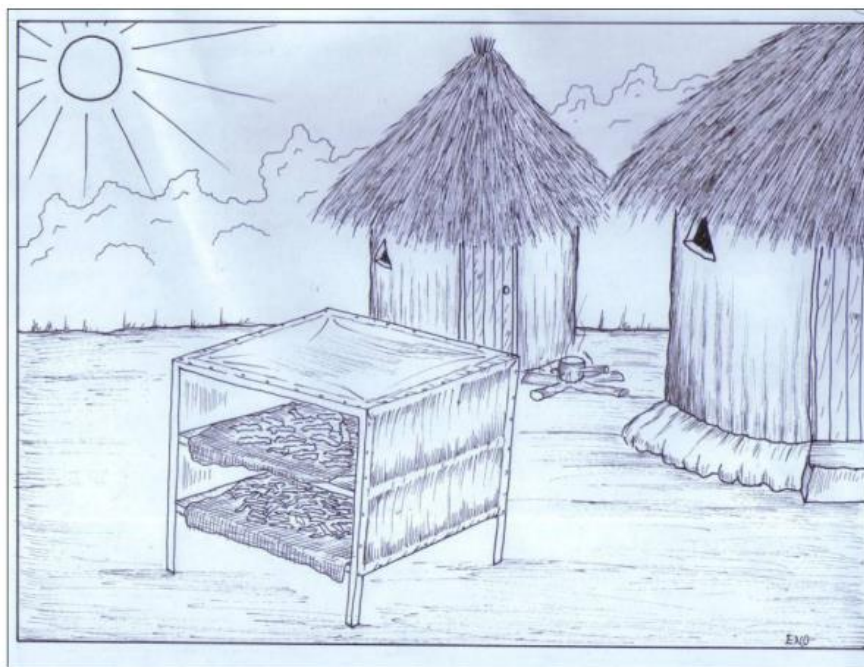
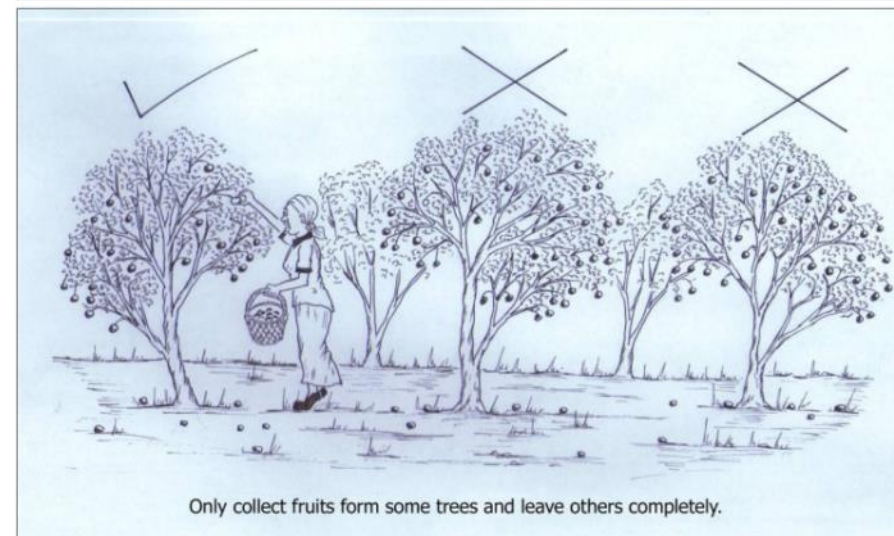
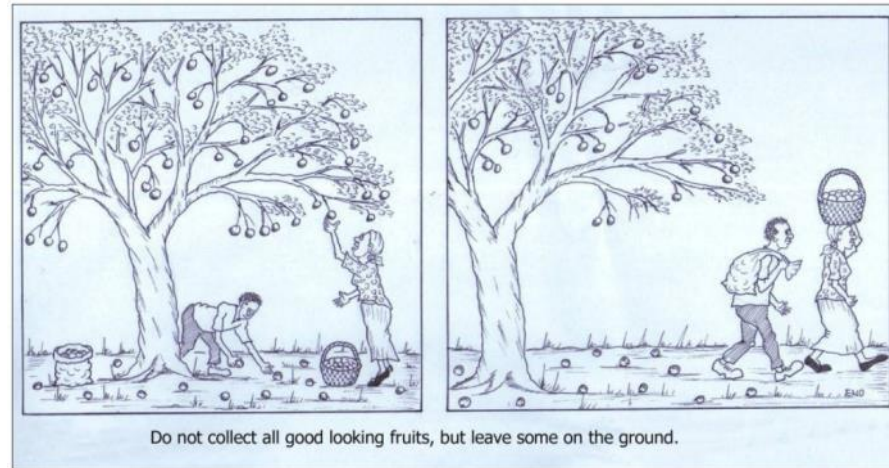
# Cost was considered most important factor by farmers in Ghana



# General rules and guidance on the use of pesticidal plants

-  Pesticidal plants usually do not kill insects quickly. Exposed insects may take a few days to die. PPs can be toxic but also act through repellency, anti-feedancy, growth regulation. Farmers need to observe effects of PP application over longer time periods. Results may not be as dramatic as experienced with synthetic pesticide use.
-  Plant species identification, collection time, collection place, processing method and application method can all make a difference in how well a pesticidal plant works. For some plants it doesn't matter whereas others plants can be more variable.
-  We don't have all the answers, but we do have some. Farmers should be encouraged to experiment, e.g. establish efficacy before widely using, try different plants, concentrations, mixing different plant species together...








Sola et al. [Guidelines for the Sustainable Harvesting of Traditional Medicinal Plants in Zimbabwe](#). SAFIRE, Harare, Zimbabwe 26 pp.

# General rules and guidance for spraying pesticidal plant extracts on field crops

- 🔄 Shade dry collected plant materials, exposure to sunlight will often reduce efficacy
- 🔄 Store in dry, dark conditions until ready to use
- 🔄 Shortly before use, grind/pound/sieve to fine powder. This increases extraction in water.
- 🔄 To make up an extract for spraying on a crop, add powdered plant in water overnight to be used next day (approx. 24 hours). For 1%, add 10 grams powder per 1 litre water, for 10% solution add 100 grams per litre. Do not try to make extracts higher than 10% (reduced extraction efficiency). Filter through cloth to remove particles that will clog sprayer.

# General rules and guidance for spraying pesticidal plant extracts on field crops

-  Adding soap during extraction should be a general rule. Soap will help extract compounds that are not water soluble. 0.1% soap is made by adding 1 ml soap per litre. This also helps spread the extract on the plant leaves more effectively.
-  Many compounds in plants break down quickly in sunlight. Spray extracts in late afternoon or evening to maximise contact time with insects.
-  Pesticidal plants need to be sprayed more frequently than commercial synthetics – because of quicker breakdown and because they often don't kill all insects in one application. Weekly spraying of several PPs has been shown to be as effective as commonly used synthetics.



# What other reason is there for adding soap to the extract?



## Surfactant

- 🔄 Stops application becoming droplets
- 🔄 Encourages spreading/sticking
- 🔄 Encourages adsorption to insects
- 🔄 Optimises extraction
- 🔄 Prevents nozzle clogging

Leaf surfaces are waxy  
– like oils they are repellent to water.



# SAFETY!!!!



# Making extracts for spraying on field crops



- ♻️ 1 ml soap per litre, 10 litre bucket has 10 ml soap
- ♻️ 10 g of plant powder per litre = 1%. 100 g of plant powder per litre = 10%
- ♻️ Make up day before use in afternoon
- ♻️ Extract for 24h
- ♻️ Filter into sprayer
- ♻️ Spray in evening
- ♻️ Repeat spray weekly



# Making extracts for spraying on field crops



- 🌿 For plant species that can be sprayed at low concentrations – 1% w/v
- 🌿 Make up with 10 ml soap per litre and 100 g plant powder per litre – 10% PP with 1% soap
- 🌿 Then dilute down to 1% PP with 0.1% soap
- 🌿 Higher soap increases rate of extraction







# General rules and guidance for applying pesticidal plants for post-harvest storage


- 🔄 Shade dry collected materials, sunlight will often reduce efficacy
- 🔄 Store in dry, dark conditions until ready to use
- 🔄 Shortly before use, grind/pound/sieve to fine powder. Admixed powder with grain is more effective. But there may be good reasons to use whole leaves or layering whole plants to more slowly release volatiles or reduce grain tainting with powder.
- 🔄 Dipping in plant extracts combined with solarisation can be highly effective, particularly for beans, cowpeas and other stored legumes. Requires more labour and good drying conditions.
- 🔄 Depending on storage duration, may need repeated application
- 🔄 Wash / winnow grain that has been treated with PPs before grinding / cooking

# Post-harvest storage questions

 Do you store at household or quickly sell?

 Food

 Seed

 What would make you store more, for longer? if you could manage pest damage?

 How do you currently control insects?

# Is your grain dry enough < 15%?



- ♻️ Grain gets harder as it gets drier
- ♻️ Experienced farmers can tell by
  - ♻️ Biting
  - ♻️ Pinching
  - ♻️ Listening when pouring or rattling it

# Is your grain dry enough?

## Materials required

- ♻️ A clean **dry** glass bottle of about 750 ml capacity with a cap that makes it airtight
- ♻️ Some common salt



## How to do it

- ♻️ Salt must be dry
- ♻️ Place the salt in hot sun in a thin layer on some plastic sheeting for at least 3 or 4 hours - until the salt is hard
- ♻️ Turn the salt at intervals during this time
- ♻️ Store the dry salt in a sealed container





# Is your grain dry enough?

**This is what you do when you are ready to do the test**

- 🔄 Fill one third of the dry bottle with the grain sample (250g to 300g)
- 🔄 Add 2 tablespoons of salt (20g or 30g)
- 🔄 Close the bottle tightly with its cap or cork
- 🔄 Shake the bottle vigorously for 1 minute
- 🔄 Leave the bottle to rest for 15 minutes

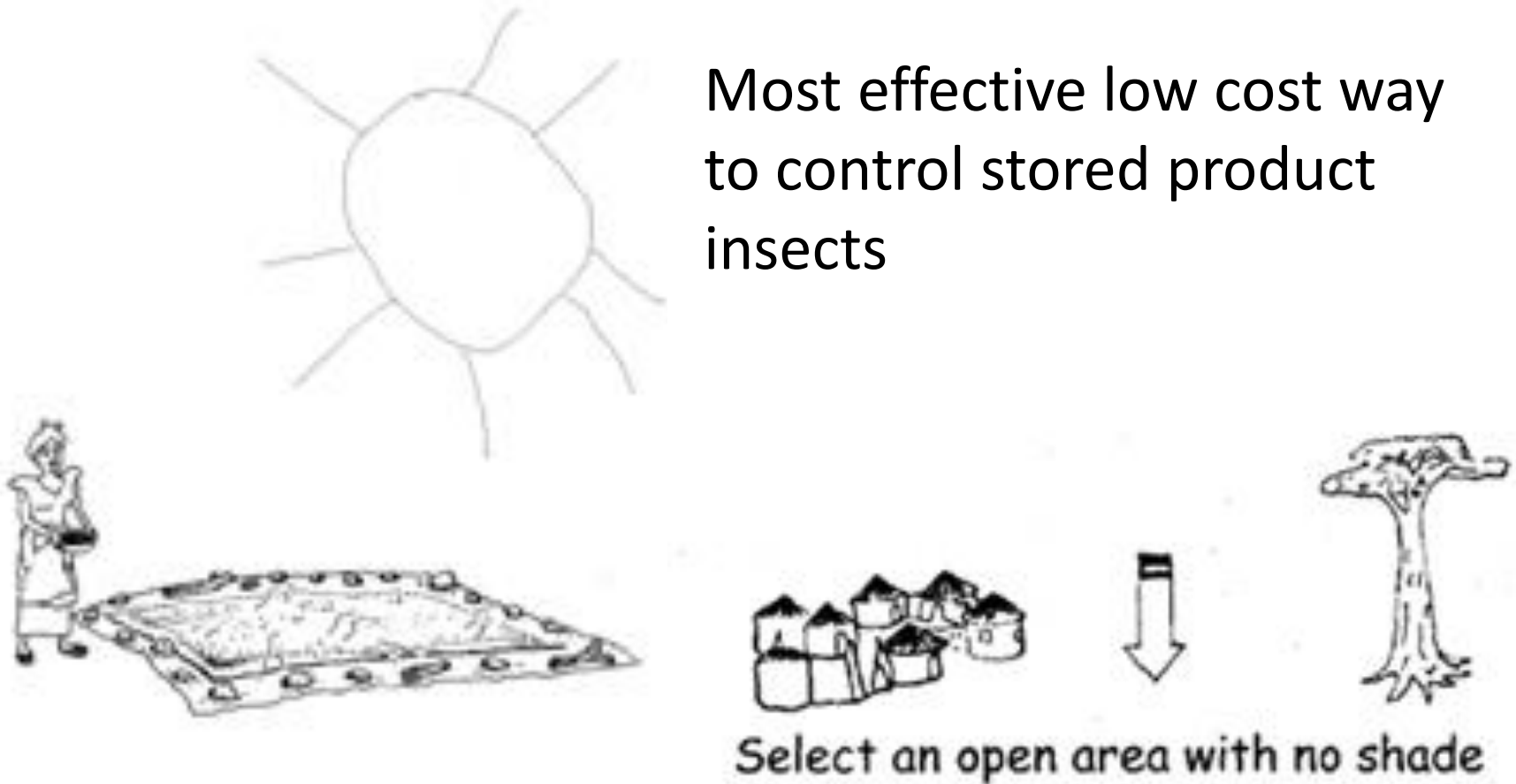
If salt sticks to sides of bottle then moisture content above 15% - **not safe for storage**

If salt does not stick to bottle then moisture content below 15% - **is safe for storage**



# Solarisation

Most effective low cost way  
to control stored product  
insects

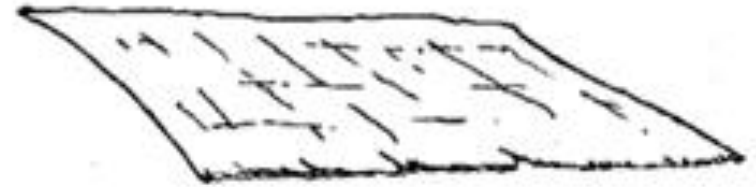


Select an open area with no shade, sweep  
the area to remove any stones or rubbish

# Solarisation



Bring up a straw mat to prevent heat being lost into the ground

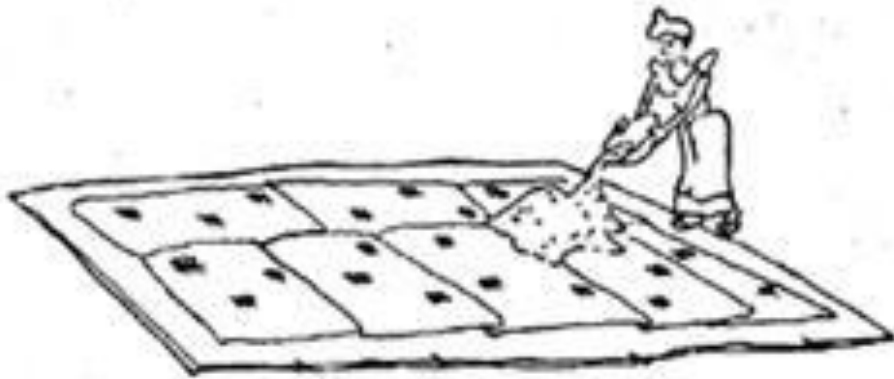


Lay the mat out so that it is flat on a clean area of exposed ground



Get hold of jute sacs and lay them flat out all over the mat.

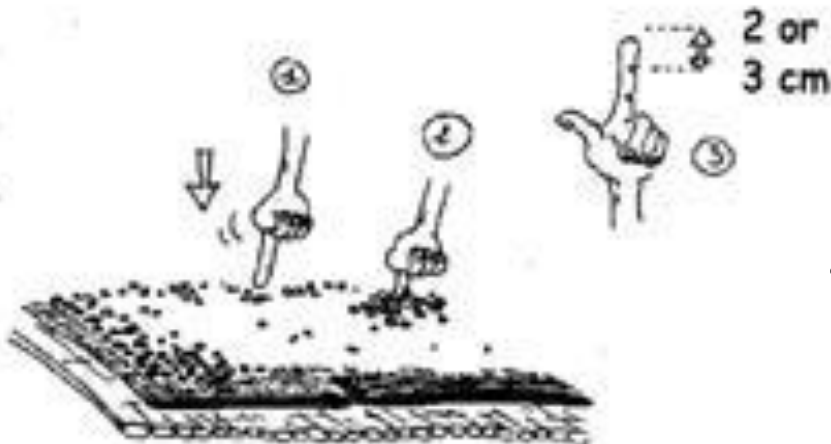
# Solarisation



Pour cowpeas over the jute sacs



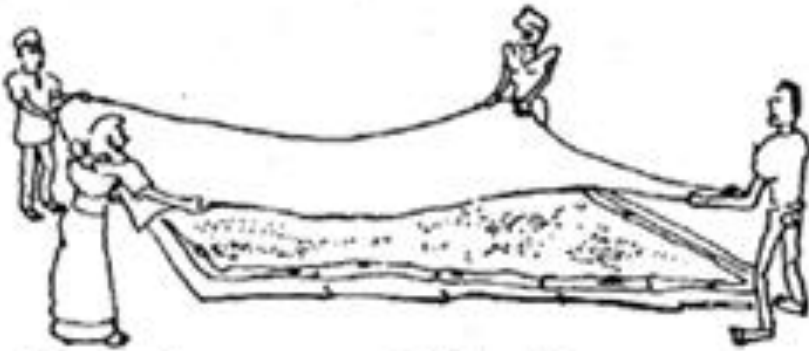
Spread cowpeas over the jute sacs evenly in a THIN Layer



Ideally cowpea should be one grain deep but if space is short not more than 2 cm.  
First finger joint



# Solarisation



Place a large transparent plastic sheet over the grain - FLAT.

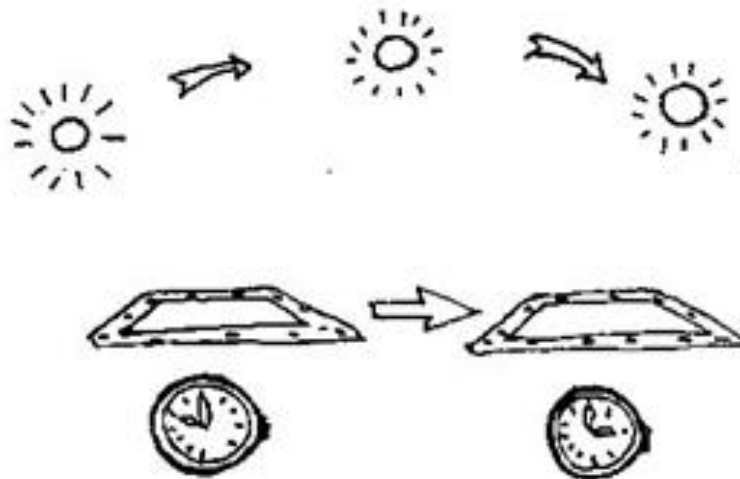


Use stones to weigh down the edges of the sheet and hold in place.



# Solarisation

Keep animals off and prevent heat escaping – ideally every grain should touch the plastic sheet



Leave in the sun  
for as long as it  
is hot – 10  
o'clock am to 3  
o'clock pm.

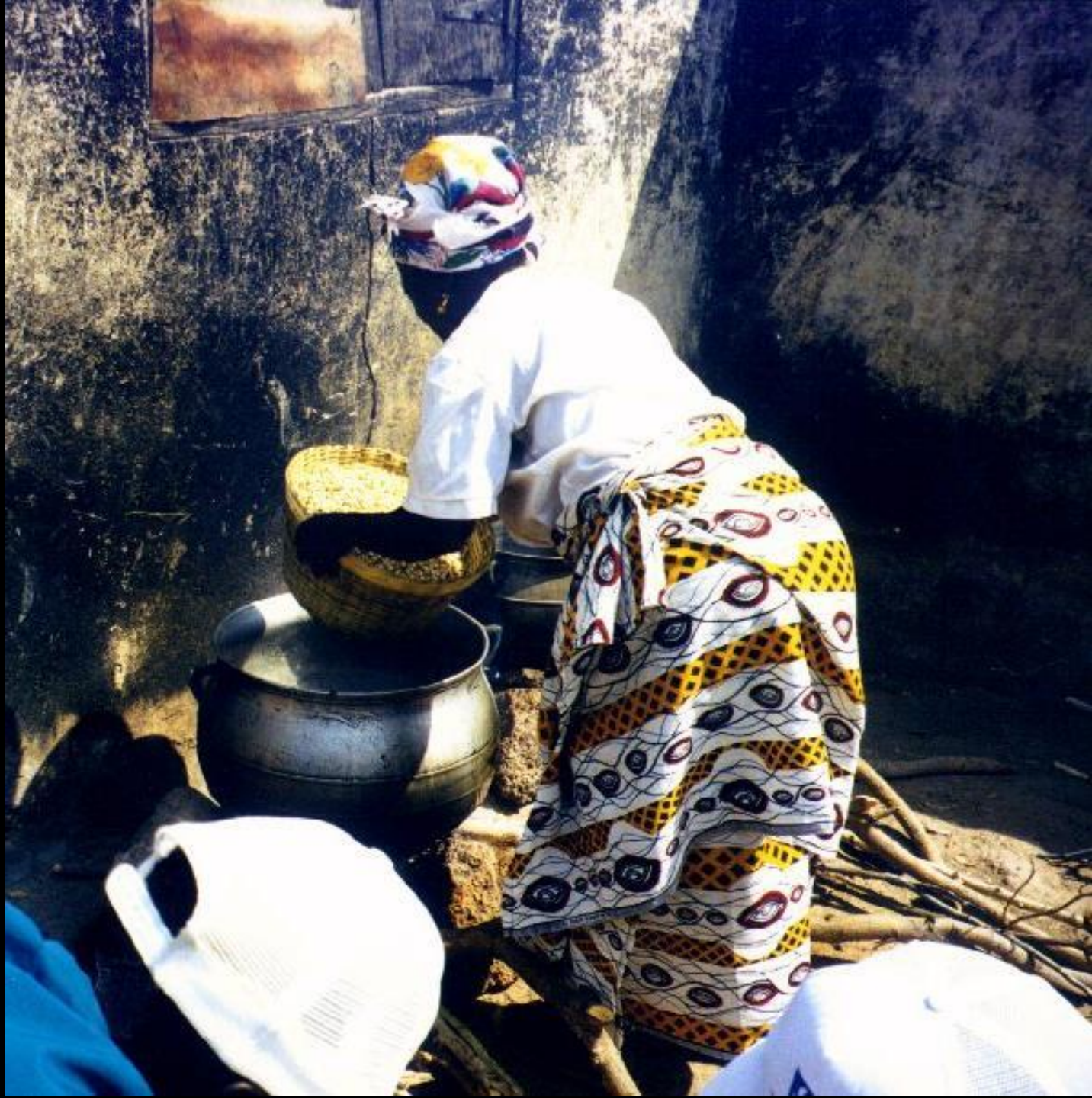




# Combining solarisation and pesticidal plant extracts for stored grain











# Mixing pesticidal plants



You will need a shovel and enough powdered plant material to treat your grain



Make a heap of the grain on a clean concrete floor, tough plastic sheet, tarpaulin or metal sheet **(not on bare earth)**



# Mixing pesticidal plants

**Always wear a face mask/bandana to prevent inhaling powder.**



Apply plant material

1 to 2 cups of plant material to 100 cups grain (1-2%). **Try and get advice for specific plants.**

Sprinkle powder all over the heap of grain, making sure the wind does not blow it away.

-similar to Acetlic/Actellic SC

# Mixing pesticidal plants



Using a clean shovel, gently mix the powder into the heap as well as you can.



# Mixing pesticidal plants



Shovel the heap to  
another part of the  
clean plastic sheet/  
tarpaulin/ concrete  
floor

# Mixing pesticidal plants



Then shovel it back again.

# Mixing pesticidal plants



Then shovel it back again for a third time.

When you have finished you shouldn't be able to see the plant material

# Mixing pesticidal plants with maize cobs or unthreshed millet, sorghum

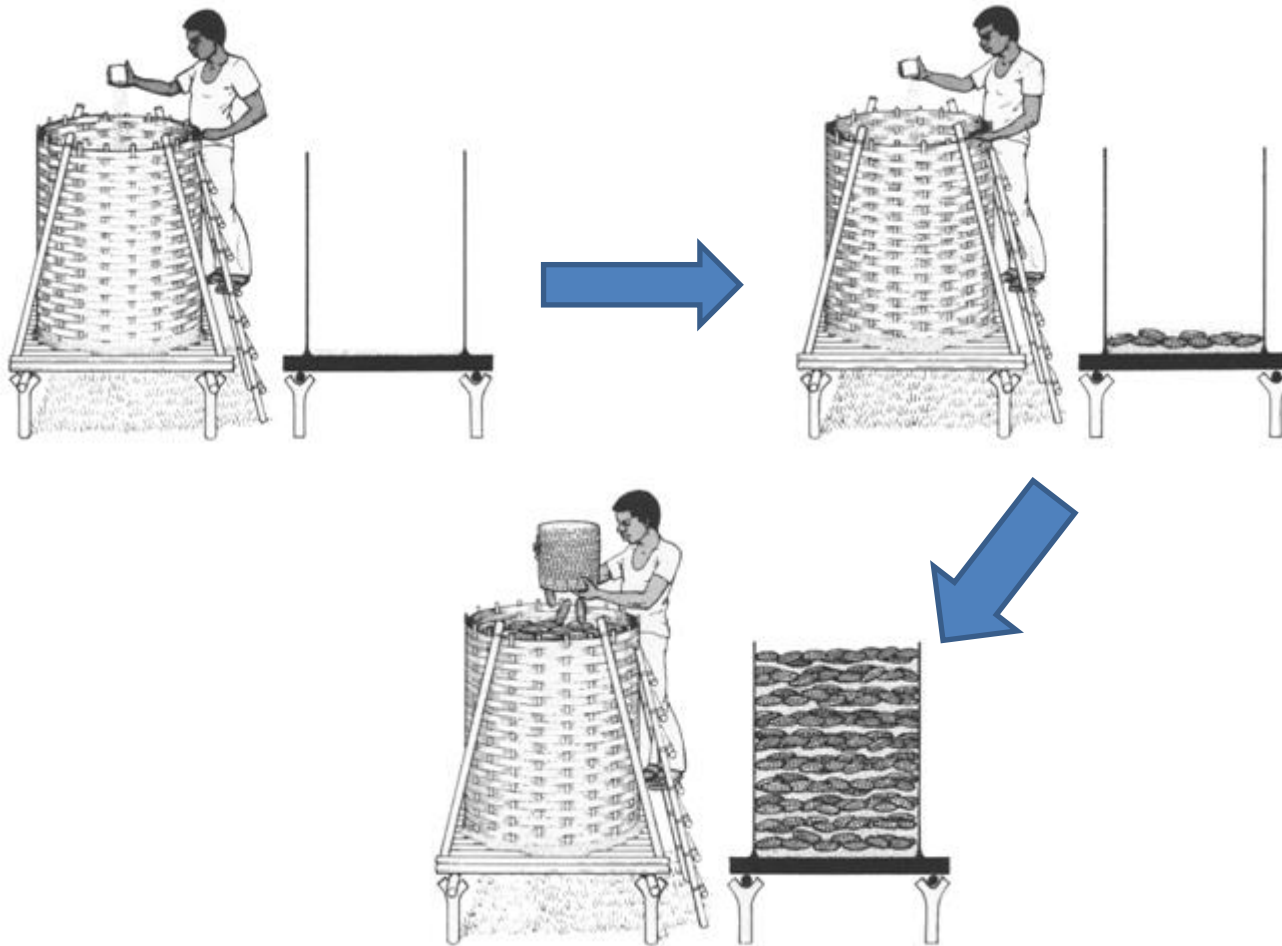
For unthreshed grain  
e.g. maize, millet or Sorghum



The tin can sprinkler can be made using a clean tin with a tightly fitting lid. About 10 holes should be made in the lid of the tin using a 5 cm nail or similar pointed tool

# Mixing pesticidal plants with maize cobs or unthreshed millet, sorghum

Apply in layers





# Pesticidal plant species that are

- ♻️ Weeds, invasive, fast growing, perennials, easy to propagate
- ♻️ Woody, slow-growing, rare, difficult to propagate, over-collected
- ♻️ Cultivated, food, spice, waste products



**Weeds, invasive, fast growing, perennials,  
easy to propagate**

# *Azadiracta indica*

- ♻️ Commonly called the Neem tree
- ♻️ Invasive and found across sub-Saharan Africa, although distribution is patchy and does not grow well in all habitats
- ♻️ Reported use in field pest management, and post-harvest storage. Very high level of evidence on efficacy when using seed oil or seed powder. Leaves are much less effective.
- ♻️ Many medicinal uses, timber, firewood
- ♻️ Fast growing and relatively easy to propagate from seed





# *Azadiracta indica*

- 🌿 Leaves can be collected anytime. Seeds must be collected when they are fully ripe (yellow) and not yet fallen to the ground. Seeds rapidly rot on the ground and become infected with *Aspergillus* fungi that produce mycotoxins and such seeds should not be used.
- 🌿 Main active ingredient, azadirachtin, is only found in the seed and not present in the leaves. The oil can be pressed out of the seeds or the seeds can be ground into an oily powder. The oil is smelly and taints wooden processing equipment and, therefore, often not extracted at the household level.
- 🌿 Neem oil can be diluted with water to 1% v/v and 0.1% soap for very good efficacy. Neem oil should not be used in post-harvest protection due to tainting and risk of mycotoxin contamination.



# *Azadiracta indica*

- 🌿 Neem works as an antifeedant and growth regulator so don't expect immediate results. Insects will not quickly die and may stay on the plant but not eat.
- 🌿 Extracts from dried leaves are best at higher concentrations, e.g. 10% w/v
- 🌿 Powdered leaves can be admixed with stored products, higher concentrations necessary, e.g. 5% w/w
- 🌿 Safety issues: azadirachtin and other neem compounds have been tested and shown to have no adverse effects on people. There are several commercial products sold (USA, India, Canada, China) and many medicinal uses and products, particularly in India.

# *Melia azedarach* and *Melia volkensii*

- 🌱 *M. azedarach* commonly called Persian lilac or Chinaberry. *M volkensii* as *Mukau*
- 🌱 *M. azedarach* found across eastern and southern Africa and considered invasive. *M. volkensii* found across Ethiopia, Somalia, Kenya, Tanzania
- 🌱 Used in similar ways to Neem
- 🌱 Valued for timber, some medicinal uses
- 🌱 Easy to propagate from seed
- 🌱 Safety: contains tetranortriterpenoids, toosandanin. Chinaberry seeds are poisonous to humans. Melia leaves more effective pesticide than neem leaves.



# *Tephrosia vogelii*

- 🔄 Commonly called fish bean plant
- 🔄 Native to Africa and well-distributed across different habitats
- 🔄 Used in pre- and post-harvest pest management and ecto-parasite control on livestock
- 🔄 Soil fertility/quality improvement through nitrogen fixation and deep roots. Thus intercropped with maize or used as cover crop and green mulch. Leaves fed to livestock for de-worming and applied to skin for skin diseases and tick/fly control, good shade and boundary plant. Traditionally used to kill/harvest fish.
- 🔄 Very fast growing and easy to propagate from seed





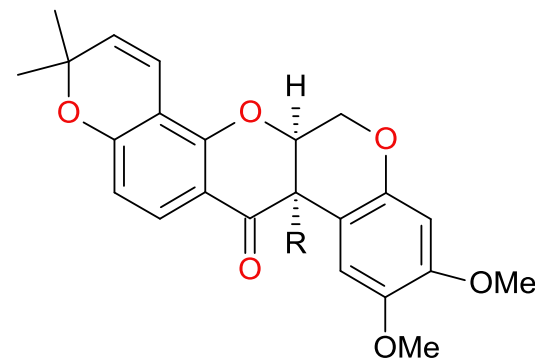
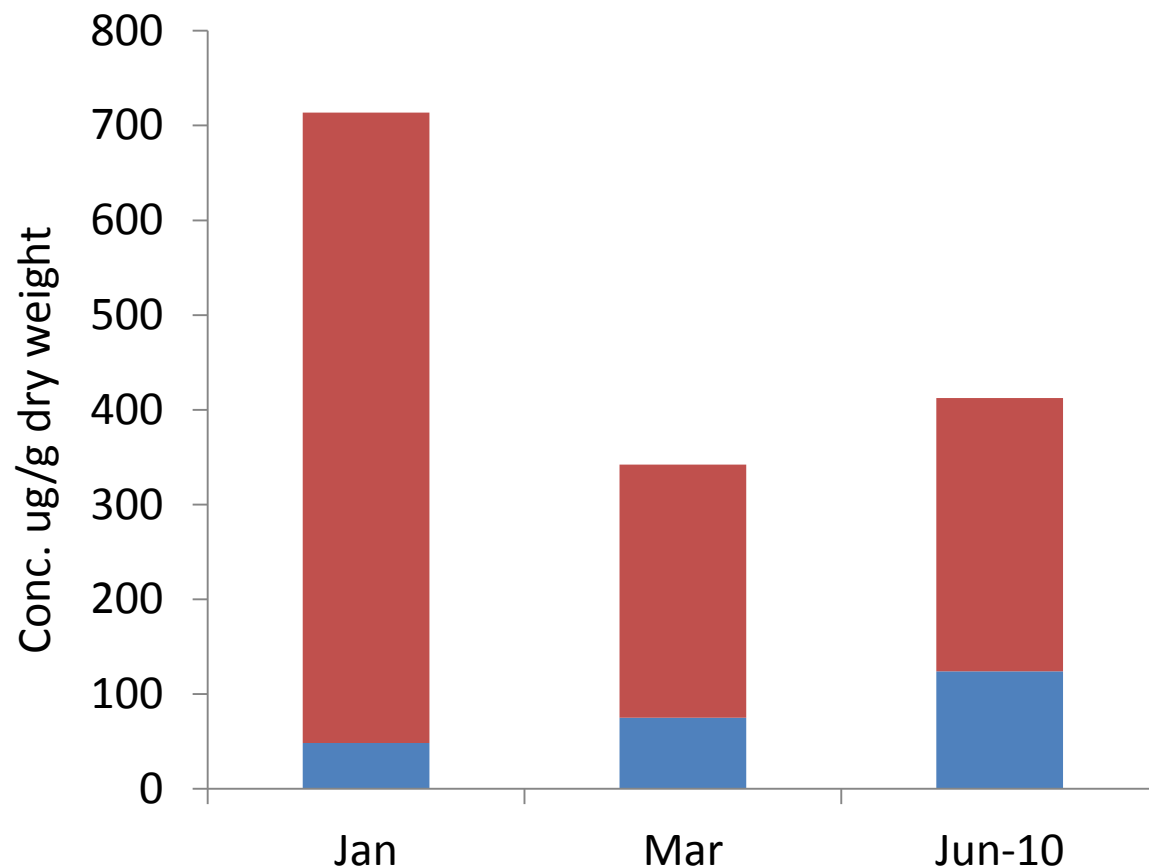
# *Tephrosia vogelii*

- 🌿 Leaves are used
- 🌿 There are two chemotypes – one that works and one that doesn't – needs pre-testing by farmer. Seasonal effects on chemistry are known for some parts of Africa.
- 🌿 Follow general guidelines to make an extract. Works as low as 1% solution. Adding soap during extraction is important.
- 🌿 Also used post-harvest, working best with stored legumes (1% w/w), less so with stored maize pests.
- 🌿 Safety issues: contains rotenoid compounds. Rotenone long used in agriculture with some debate on safety to humans (based on historical evaluation of refined commercial products)





# Seasonal change in Malawi of *T. vogelii* leaf composition of Deguelin and Tephrosin

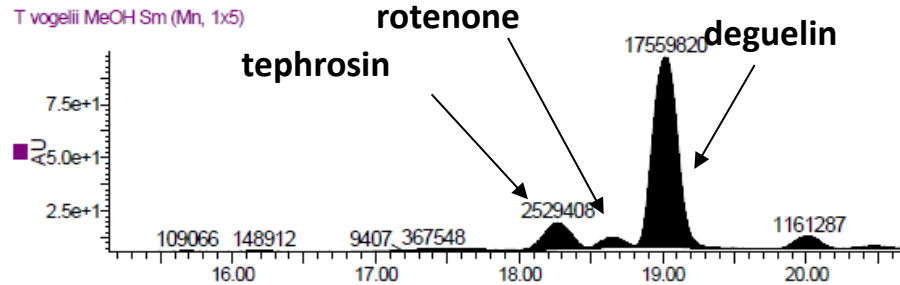


■ Deguelin

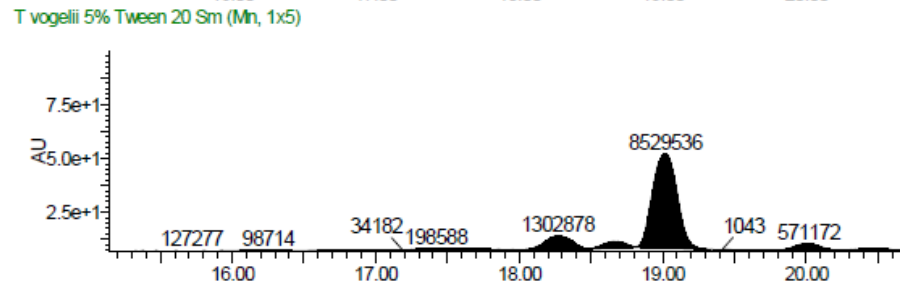
■ Tephrosin

Farmers need to harvest Tephrosia in January – in northern Malawi

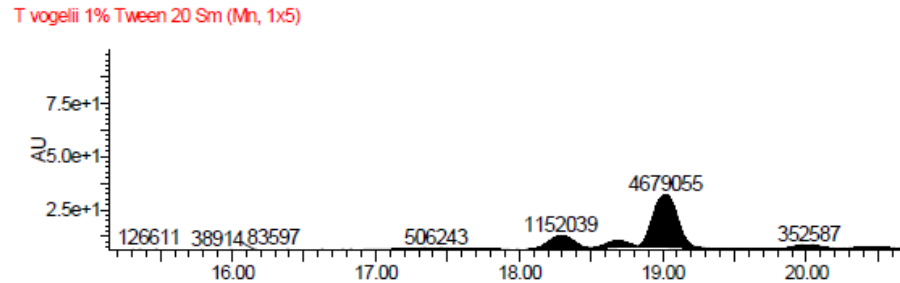
# Optimising rotenoid extraction from *T. vogelii* leaves



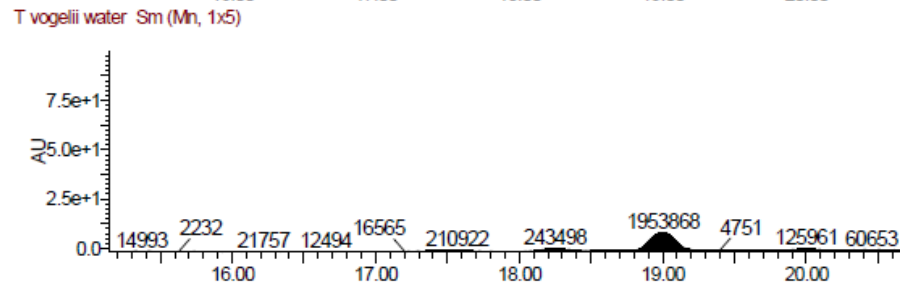
Methanol extract



5% Tween - soap



1% Tween - soap



Water

# *Dolichos kilimandscharicus*

## *Neorautanenia mitis*

- ♻️ Commonly called veld lupin
- ♻️ Native to eastern and southern Africa
- ♻️ Used in pre- and post-harvest pest management and ecto-parasite control on livestock
- ♻️ Large turnip-like root contains rotenoids and used in same ways as *Tephrosia vogelii* leaves
- ♻️ Very fast growing and easy to propagate from seed
- ♻️ As uprooting entire plant, should only harvest from wild after seed production/dispersal



# *Dolichos kilimandscharicus*

## *Neorautanenia mitis*

- 🔄 Root tuber is used
- 🔄 Root is dried and ground to powder
- 🔄 Follow general guidelines to make an extract. Works as low as 1% solution. Adding soap during extraction is very important.
- 🔄 Also used post-harvest, working best with stored legumes (1% w/w), less so with stored maize pests.
- 🔄 Safety issues: contains rotenoid compounds.





# *Lippia javanica*

- 🌿 Commonly called fever tea tree, lemon bush
- 🌿 Woody shrub found throughout eastern and southern Africa usually on forest fringe, grassland on hillsides and stream banks
- 🌿 Used in pre- and post-harvest pest management and ecto-parasite control on livestock. High in essential oils with fumigant effect
- 🌿 Leaves are used as a medicinal, herbal tea to treat coughs and aching muscles, commercial products available in some countries
- 🌿 Easy to propagate from seed or cuttings, can be invasive

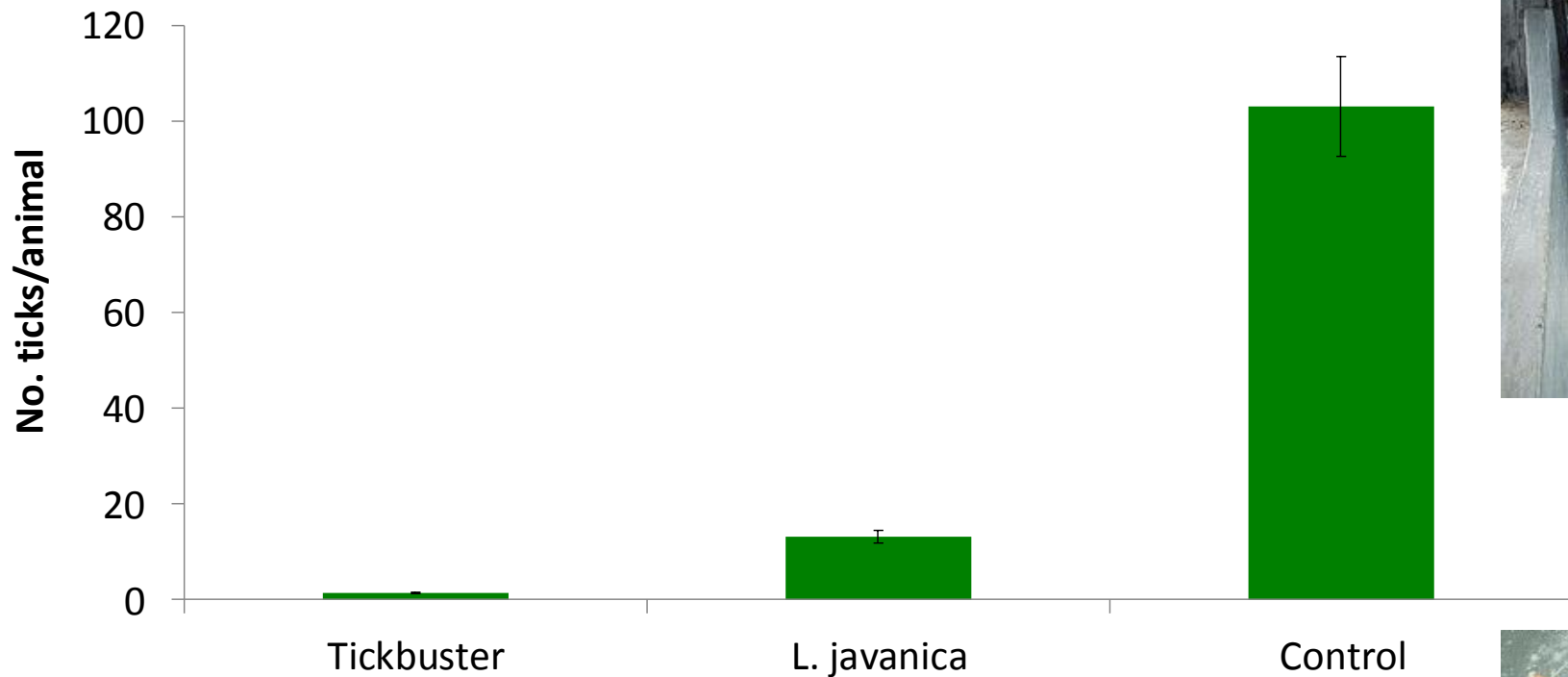


# *Lippia javanica*

- 🌿 Essential oil chemistry varies dramatically both within and between natural plant populations and this can have big impact on efficacy. Geography and season affect chemistry. Farmers should pre-trial before wide use
- 🌿 Taxonomy not quite clear, with several varieties
- 🌿 Some effort to commercialise essential oil pesticide derived from Lippia in USA



# Effect on tick count / animal when treating cattle with 5% *Lippia javanica*

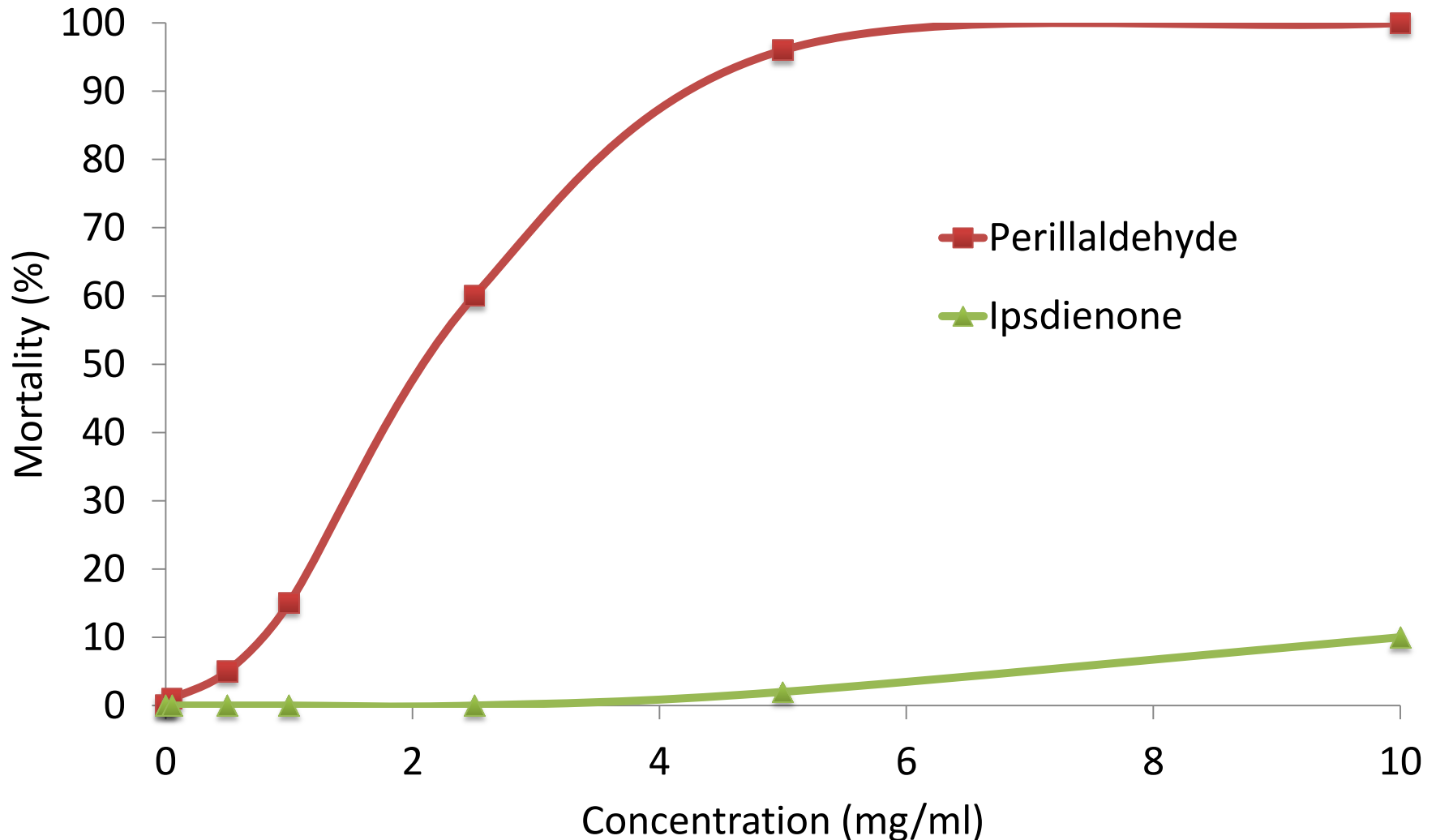


# Relative quantities of components in Lippia essential oil from 3 locations in Malawi - October

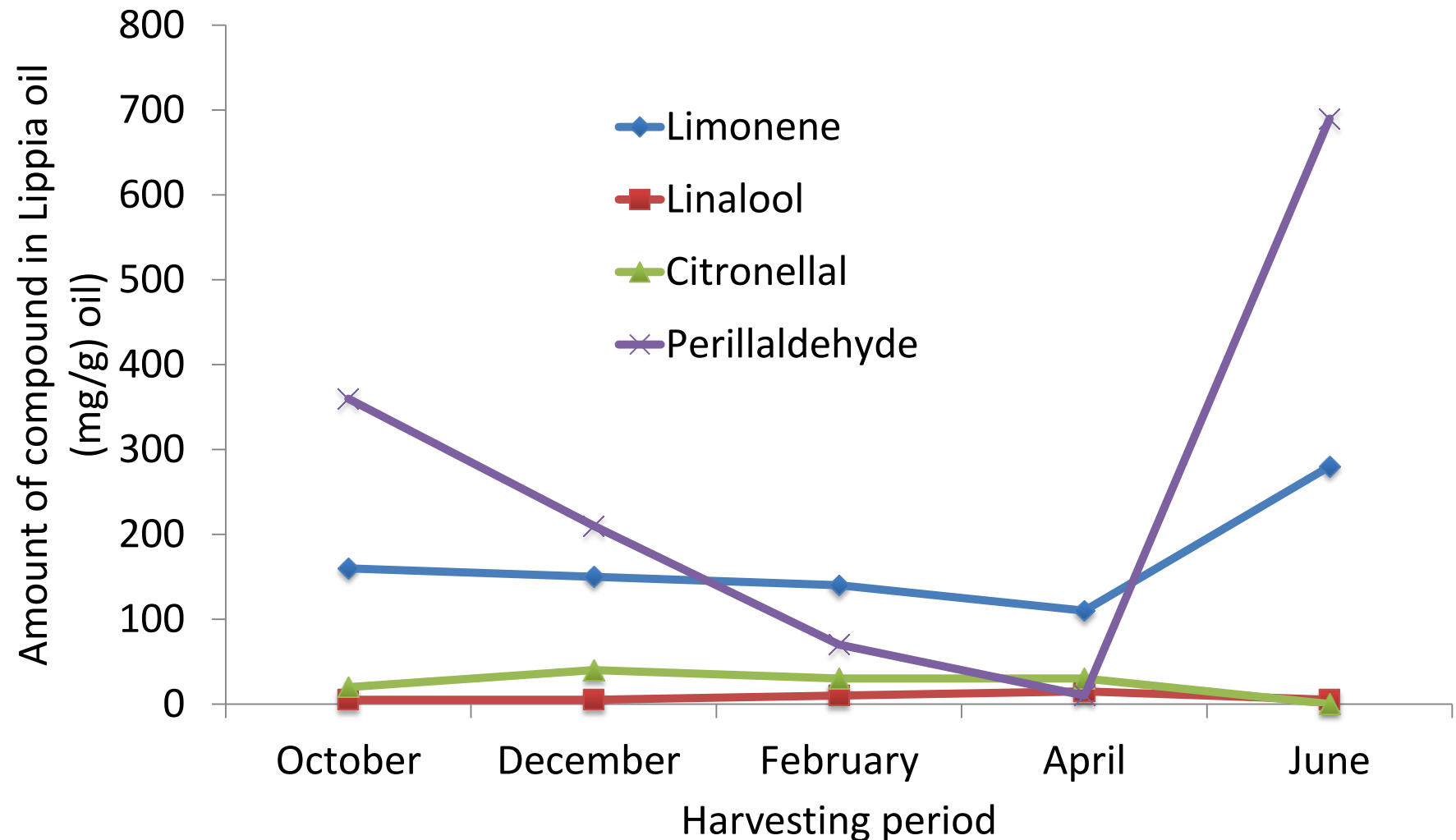
	Location		
Compound	Nchenachena	Chikangawa	Jenda
Perillaldehyde	44 %	0	0.55 %
Limonene	24 %	0	13 %
Ipsdienone	1 %	52 %	31 %
Piperitone	2 %	0	22 %
Germacrene D	4 %	5 %	5 %
(+)-Carvone	3 %	0	0
Sub-species	<i>L. j. javanica</i>	<i>L.j. whyteii</i>	<i>L.j. whyteii</i>



# Contact toxicity of Perillaldehyde and Ipsdienone against *S. zeamais* after 48h



# Limonene, linalool, citronellal and perillaldehyde in Nchenachena Lippia leaf oil over time



# *Lantana camara*

- ☞ Commonly known as big sage, tickberry, black sage, lantana
- ☞ Highly invasive forming dense thickets, toxic to cattle, out-competes / smothers many local plant species, good mosquito repellent if planted around houses
- ☞ Extracts around 5% w/v are effective on a wide range of crop pests, in post-harvest admixed powders (2-5% w/w) have been shown effective against maize and bean weevils
- ☞ Many sub-varieties with geographic and seasonal differences affecting chemistry. Farmers need to pre-trial with their local sources



# *Vernonia amygdalina*

- Commonly called bitter leaf
- Small woody shrub found across sub-Saharan Africa
- Many medicinal uses, de-worming livestock/people, anti-malarial, anti-biotic, vegetable, e.g. bitter leaf soup in Nigeria
- Has been used to control fungal and bacterial diseases on field crops and as insecticide, best at higher extract concentrations of 10% w/v
- Easy to propagate, cultivated in some parts of Africa





# *Dysphania ambrosioides*

- 🌱 Commonly called wormseed, Jesuit's tea
- 🌱 Invasive weed throughout Africa
- 🌱 Used as spice in Mexican food, essential oil used for de-worming, malaria
- 🌱 Used for post-harvest protection, often using entire plants/leaves and periodically agitating to release volatile compounds. 1% w/w works well for bean weevil, but higher amounts (5% w/w) for maize weevil. Extracts at 10% w/v have efficacy against field pests
- 🌱 Easy to propagate, cultivated in some places, commercialised as essential oil pesticide in USA



# *Tithonia diversifolia*

- ♻️ Commonly called Mexican sunflower or Mexican marigold
- ♻️ Invasive weed found across eastern and southern Africa along roadsides, field margins, other disturbed habitats
- ♻️ Reported use in field pest management, and post-harvest storage. Some good evidence of general efficacy.
- ♻️ Medicinal, livestock fodder (leaves and soft branches), firewood (woody branches)
- ♻️ Easy to propagate from seed and cuttings



# *Tithonia diversifolia*

- 🔄 Flower buds, open flowers and leaves are used
- 🔄 We don't know how season/environment affects efficacy
- 🔄 Follow general guidelines to make an extract. Works as low as 1% solution, but better results with 10% solution. Evidence of use on wide variety of vegetable crops – tomato, beans, brassicas
- 🔄 Also used post-harvest with maize and legumes as admixed powder 1-5 % w/w
- 🔄 Safety issues: contains sesquiterpene lactones and diterpenoids that have not been evaluated. However, ingested as medicinal remedy.





# *Tagetes minuta*

- 🌱 Commonly called southern cone marigold, stinking roger, black mint, Mexican marigold (as is *Tithonia*)
- 🌱 Found everywhere, highly invasive, considered a crop weed in many places
- 🌱 A culinary herb in South America, herbal tea, leaves can be irritant, growing it can remove persistent weed species, good nematocide
- 🌱 Roots are nematocide and insecticide, leaves are good insecticide. Extract at 1-5% w/v effective against range of crop/soil pests. Whole plants in post-harvest storage
- 🌱 Easy to propagate from seed





# *Tanacetum cinerariifolium*

- 🌿 Commonly called Pyrethrum
- 🌿 Grown in highland areas (1,800 to 2,700 masl) throughout eastern and southern Africa as a cash crop for natural pesticide. Kenya used to produce 90% of world's supply – now Tasmania produces 90%.
- 🌿 Many established uses in all crops, post-harvest, flea, tick, domestic/urban pest control
- 🌿 Compounds are difficult to extract at local level, but not impossible. Could be used more widely in African agriculture. Access to PyMarc ? – waste extraction product
- 🌿 Very easy to propagate and grow



# *Solanum incanum*

- 🌿 Soft wooded shrub commonly called bitter tomato, thorn apple, wild aubergine
- 🌿 Found throughout sub-Saharan Africa and an abundant weed of disturbed and overgrazed areas, road sides margins of woodland, riverine and evergreen forest
- 🌿 Many medicinal uses, analgesic, antibacterial, skin infections. Has been shown to cause skin cancer so care should be taken when using.
- 🌿 Fruits are dried, crushed and extracted in water at 5% w/v for livestock tick control or field pest management. Not recommended for post-harvest control due to toxicity
- 🌿 Many varieties by region, requires pre-testing



**Woody, slow-growing, rare, difficult to propagate, over-collected**



# *Securidaca longepedunculata*



- 🌿 African violet tree
- 🌿 Found across sub-Saharan Africa in Savannah and Sahel environments
- 🌿 Many traditional uses in medicine, fibre, timber, pre and post-harvest crop protection

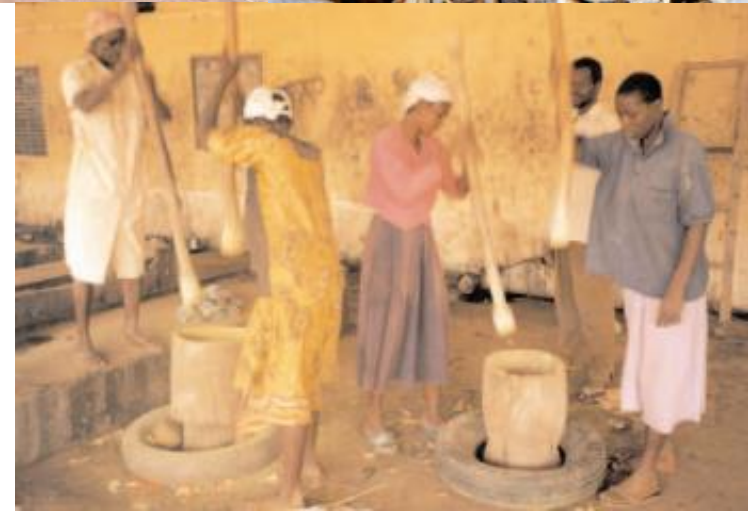




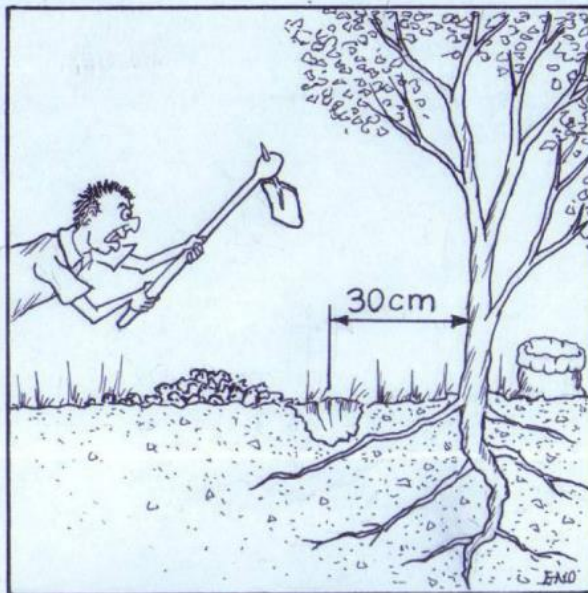
# *Securidaca longepedunculata*



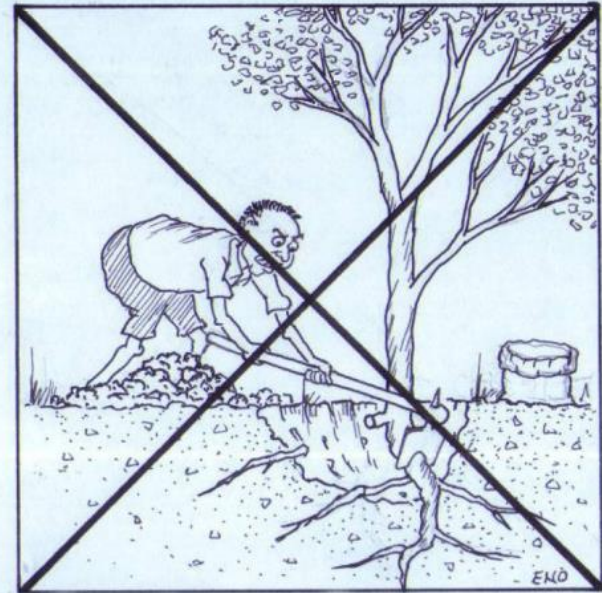
Root bark is harvested, often unsustainably



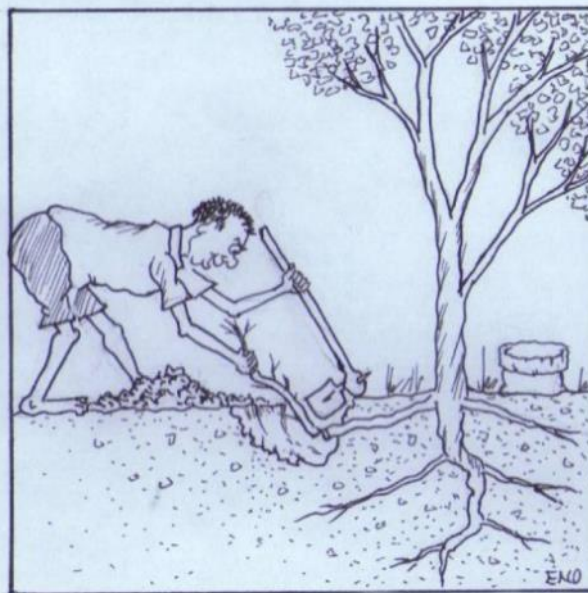




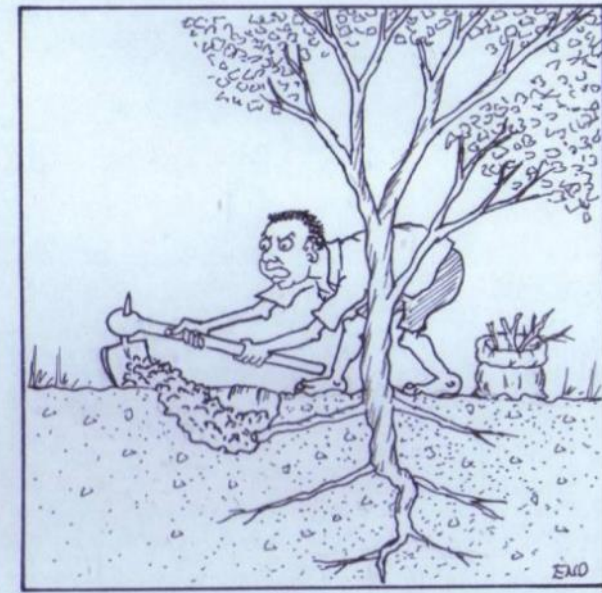
Dig the root at a considerable distance



Avoid severing the tap root










Collect only lateral roots

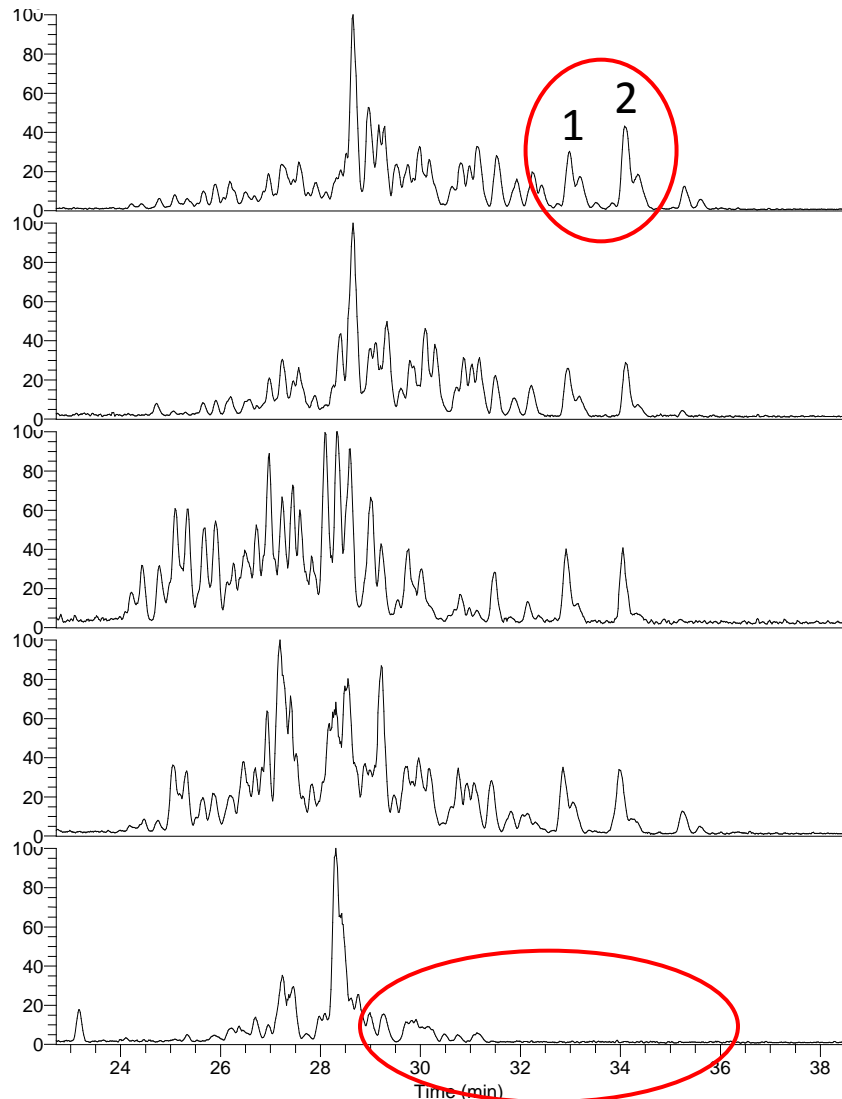


Cover the hole

# *Securidaca longepedunculata*

-  Root bark is stripped from roots, dried and ground/pounded to powder
-  Very effective in grain storage at 1% w/w admix
-  Is one of the most effective post-harvest protectants we have evaluated, even killing grain weevil and larger grain borer. Has both fumigant effect and longer term protection through presence of different chemicals
-  Chemicals easily extract in water – they are already soapy – and has been used at 1% w/v on all sorts of field crops
-  Over-collection, over-grazing, bush fires, habitat degradation have reduced it's availability in wild
-  Propagation is difficult, tree is slow growing
-  Increase supply through nursery growers?

# LC-MS chromatograms of five specimens of *S. longepedunculata* from different locations showing variation in saponin chemistry



Tamale, Ghana. Effective

Bolgatanga, Ghana. Effective

Choma, Zambia. Effective

Root bark Nchenachena,  
Malawi. Effective

Stem bark Nchenachena, Malawi.  
Ineffective in field trials



# *Zanha africana*

- 🌿 Commonly called velvet-fruited zanha
- 🌿 Found across eastern and central tropical Africa - Kenya to Mozambique, Zimbabwe and Angola
- 🌿 Another tree where root bark is harvested, used as per Securidaca (has some similar chemicals)
- 🌿 Valued for timber, fruit is eaten (but toxic seeds), some medicinal uses but fatalities have occurred.



# *Bobgunnia madagascariensis*

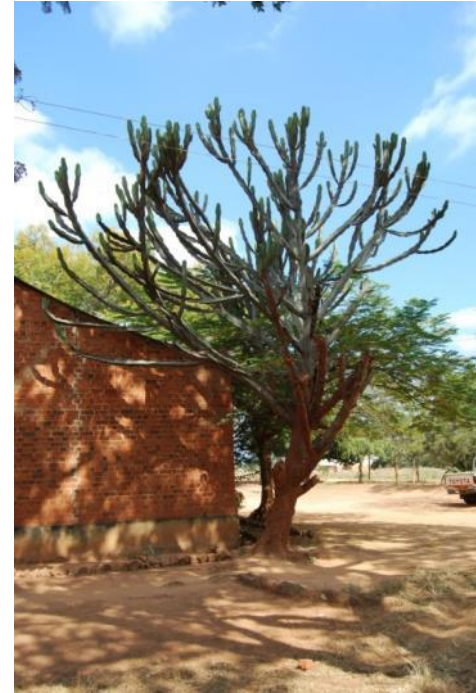
- Small deciduous tree, 3-4 m in height commonly known snake bean tree
- Found across sub-Saharan Africa, particularly West Africa, D.R. Congo, Tanzania, Mozambique, Malawi, Zimbabwe, Zambia, Botswana
- Mainly seed pods are used as pesticide, but both stem bark and root bark are also used. Seeds contain saponins that are highly effective and perhaps safer than barks
- Also for timber, firewood, medicine, anti-fungal, fish poison, insecticide, fibre and dye. Leaves and pods are poisonous to livestock
- Very easy to propagate from seed, but relatively slow growing





# *Euphorbia candelabrum*

- ❧ Succulent tree commonly known as candelabra tree
- ❧ Found across eastern, southern and horn of Africa (Sudan to Zimbabwe) but generally not in high abundance
- ❧ Long used as medicinal, particularly purgative. Latex highly irritant/poisonous containing carcinogenic ingenol diterpene esters
- ❧ Used as pesticide for field pests, but difficult to process as irritating. Although farmers do use post-harvest, this should not be recommended due to toxic diterpenoids
- ❧ Very easy to propagate and grow





# *Euphorbia tirucalli*

- 🌱 Succulent shrub/tree commonly called pencil tree, finger euphorb, firesticks plant
- 🌱 Found across eastern and southern Africa along roadsides, homesteads, eroded soils
- 🌱 Long used as medicinal, latex can be toxic and severely irritating. Death and blindness have been recorded. Used for fencing / border / hedge planting and wind break
- 🌱 Well-known as pesticide for aphids and other field pests, mosquitos. Although farmers do use post-harvest, this should not be recommended due to toxic diterpenoids
- 🌱 Very easy to propagate and grow



# *Cissus quadrangularis*

- ♻️ Succulent climber commonly called Devil's Backbone
- ♻️ Found across sub-Saharan Africa but patchy distribution, often around homesteads
- ♻️ Long used as medicinal – pain relief, bone healing, antibiotic, ulcers, weight loss.
- ♻️ Less known as pesticide, but does have some insecticidal properties – needs more evaluation
- ♻️ Very easy to propagate and grow





# *Aloe ferox*

- ❧ Succulent commonly known as bitter aloe, red aloe, cape aloe
- ❧ Native to South Africa but spread though southern and eastern Africa across rocky, dry grassland areas
- ❧ Many medicinal uses, purgative, skin rashes, burns, wounds
- ❧ Dead, dried leaves can be burnt to ash which is very good post-harvest protectant at 2-5% w/w. Repels insects when planted as live fence around crop
- ❧ Easily propagated from seed, but Aloe species are generally rare & over-collected

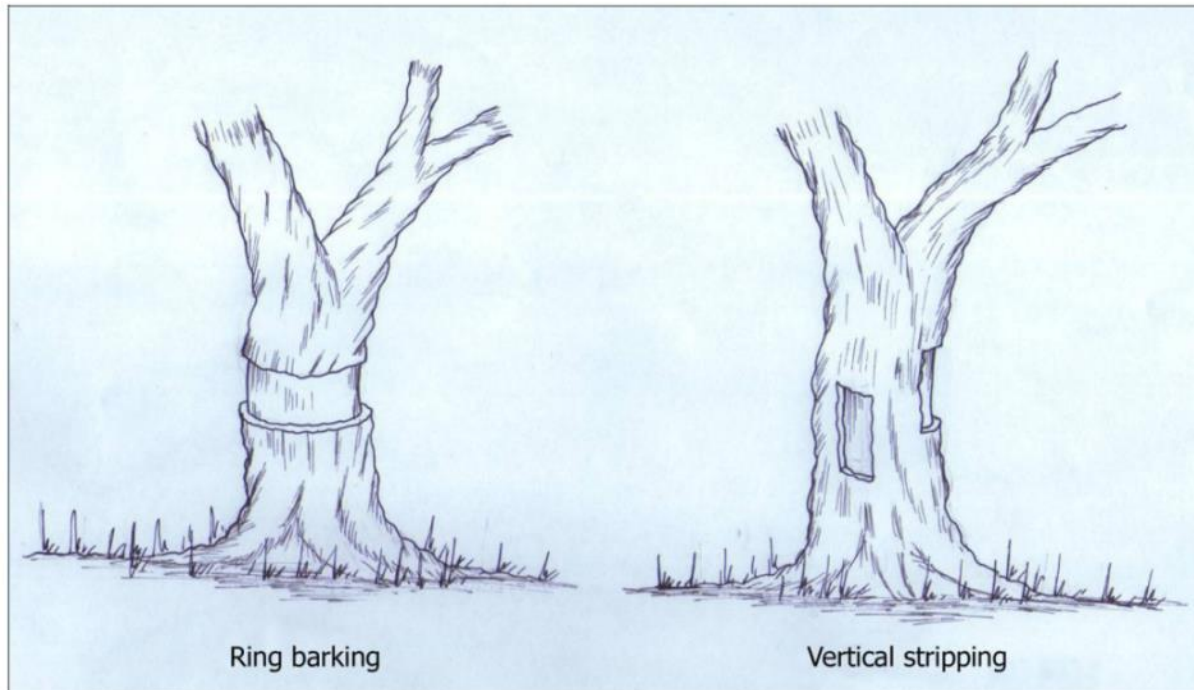




**Rare species are rare for a reason**

# *Khaya senegalensis*

- 🔄 African mahogany – native to West Africa
- 🔄 Bark is very effective insecticide, medicinal, timber highly sought after
- 🔄 Now very rare, on IUCN red list
- 🔄 Debarking living trees held “IN COMMON” by communities, community breakdown / migration leads to species loss



**Cultivated, food, spice, waste products**



# *Capsicum annuum*

- ♻️ Commonly known as chilli pepper
- ♻️ Dried and ground fruits, 1% w/v as post-harvest protectant, however can taint the grain (and is difficult to make powder). Some farmers mix in whole chilies, which can be recovered with less tainting, but must mix at high rates of at least 10%
- ♻️ Extract of fresh fruits at around 5% is good for many field pests
- ♻️ Efficacy depends on variety strength



# *Piper nigrum, P. guineense*

- Commonly known as black pepper, Ashanti pepper
- Extracts of powdered leaves and fruits are good insecticides, peppercorns can be mixed with stored grain but must do a high concentrations, e.g. 10%+ w/v. Ground pepper effective at 1% w/v for stored beans and cowpeas.





# *Nicotiana tabacum*

- ☞ Commonly known as tobacco, contains nicotine – one of the oldest known pesticides
- ☞ Extract of dried leaves in water at 1 to 2% w/v is very effective. Avoid making higher concentrations as can have phyto-toxicity. Whole leaves admixed with beans/cowpeas effective, for maize, should be powdered at 5% w/v.
- ☞ Extreme toxicity to mammals, thus care when making extracts and do not make concentrated extracts





# *Citrus sinensis, C. limon, C. paradisi*

- Any kind of citrus peel can be dried and ground to powder for use as a post-harvest protectant. 1% w/v for bean weevils, 5% w/v for maize weevils. Peel acts as fumigant and repellent. Amount depends on varieties, so farmers should experiment, start with 5% and work down to 1% to see if efficacy is maintained.
- To make extract, rinds need to be chopped and soaked for 10 days. Ground peel can be boiled for 5 minutes. Amount depends on varieties. Citrus oil works well against aphids, caterpillars, flies, mosquitos, bugs



# *Allium sativum*

- ♻️ Commonly known as garlic
- ♻️ Garlic powder at 1-2% w/w used post-harvest but will taint the grain
- ♻️ Makes an effective extract for spraying on field crops, both leaves and bulbs can be used.
- ♻️ Pound fresh material, mix with water (and soap) at around 10% w/v. Fresh material has lots of water in it already so not recommended to try to make lower concentrations with fresh material





# *Ocimum gratissimum*, *O. americanum*, *O. kilimandscharicum*, *O. africanum*

- 🌀 Chemistry / efficacy varies considerably, taxonomy difficult
- 🌀 Aromatic volatiles, good as whole leave/plant in storage
- 🌀 Dried and/or fresh material can be extracted, needs to be sprayed at higher concentrations of 10% w/v





# *Cymbopogon citratus*, *C. nardus*, *C. schoenanthus*

- 🌀 Lemon grasses, citronella
- 🌀 Very popular in Thai, Asian cuisine, commercially produced insect repellent
- 🌀 Can be dried and powdered for post-harvest or dried and layered in granary
- 🌀 Fresh or dried can be extracted in soapy water. Best results at higher concentrations of 10%



# *Annona senegalensis*, *A. squamosa*

- 🌿 Custard apple, soursop, sweetsop
- 🌿 Seeds are toxic containing Annonicin, Asimicin, Squamocin which act in similar ways to rotenone
- 🌿 Grind seeds to powder, extract in soapy water 1% w/v
- 🌿 Not recommended for post-harvest use





# Conclusions

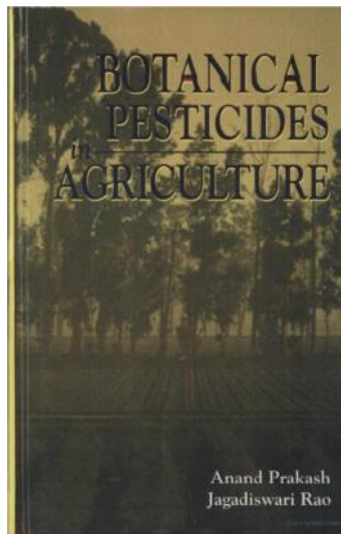
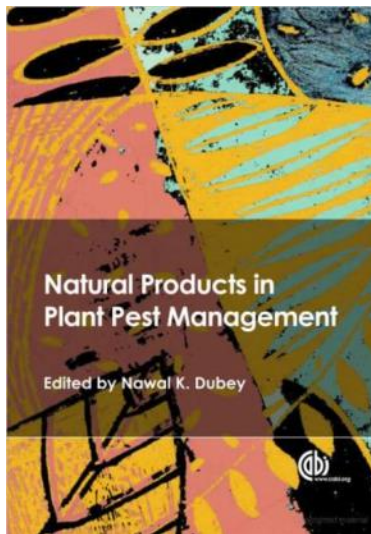
- 🌿 Many plant species are used by some farmers, but there are bottlenecks in knowledge transfer among farmers
- 🌿 Farmers need to understand PPs are not perfect solutions and can be slow acting, requiring repeated application, requiring labour to collect, process & apply
- 🌿 Using PPs are better than doing nothing and will reduce insect damage. Do farmers need to increase monitoring to appreciate?
- 🌿 Farmers should be encouraged to increase supply of PP materials they find are effective for their pest problems
- 🌿 Farmers should be encouraged to do their own experimentation





# Further reading

- 🌱 Flint, M.L. (2012) IPM in Practice: Principles and Methods of Integrated Pest Management. UCANR Publications, 292 pages.
- 🌱 Dubey, N.K. (2011) Natural Products in Plant Pest Management. CABI, UK, 293 pages
- 🌱 Stoll, G. (2000) Natural Crop Protection in the Tropics. Margraf Verlag, NL 376 pages.
- 🌱 Prakash, A. and Rao, J. (1997) Botanical Pesticides in Agriculture. CRC Press, Boca Raton, USA, 461 pages.



**IPM in Practice**

Principles and Methods of Integrated  
Pest Management

Second Edition

Mary Louise Flint  
UC Statewide Integrated Pest Management Program

University of California  
Agriculture and Natural Resources  
Publication 2018

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## Grow your own pesticidal plants

May 30, 2014 Posted by [Daisy Ouya](#)



Tithonia diversifolia on Thika Highway in Nairobi. Photo: ICRAF

Active ingredients found in wild flowers, trees and bramble have been used for millennia to control pests and diseases. Different parts of the plants are processed into decoctions or applied directly to crops or livestock, protecting them from damage, disease and infestation.

A new set of information leaflets, now available for download, describes the insecticidal and medicinal activity of 9 common pesticidal plant species in the tropics and sub-tropics. These leaflets were developed by researchers from the [World Agroforestry Centre \(ICRAF\)'s Tree Diversity, Domestication and Delivery research program](#), the University of Greenwich and the [Millennium Seed Bank Partnership](#) of Kew Royal Botanic Gardens, under the auspices of the

[African Dryland Alliance for Pesticidal Plant Technologies \(ADAPPT\)](#) network.

Backed by research findings, the authors describe the properties and uses of these pesticidal plants, as well as where they grow naturally. They further give instructions on how to grow, multiply, harvest and process different parts of the plants—leaves, seeds, fruits, bark, sap, flowers and roots—into botanical pesticides, as well as how to handle and apply these to field crops, stored commodities, or livestock.

### Simons says...



Thought-provoking blogs by ICRAF Director General Tony Simons



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Korea to support global forest restoration



A photograph of a natural landscape. In the foreground, there is a field of tall, dry, yellowish-brown grass. Behind the grass, a dense forest of green trees and shrubs covers a hillside. The trees have varying heights and some have thick, gnarled trunks. The background shows a continuation of the forested hill under a bright, slightly overcast sky.

**Thank You  
for listening**