



# African Dryland Alliance for Pesticidal-Plant Technologies **ADAPPT**

*McKnight Pesticidal Plants Workshop 5-6<sup>th</sup> Dec 2011*



THE MCKNIGHT FOUNDATION



UNIVERSITY  
of  
GREENWICH | Natural  
Resources  
Institute

# The SAPP Project

Southern African Pesticidal Plants

EU 9th Dev Fund via SADC's

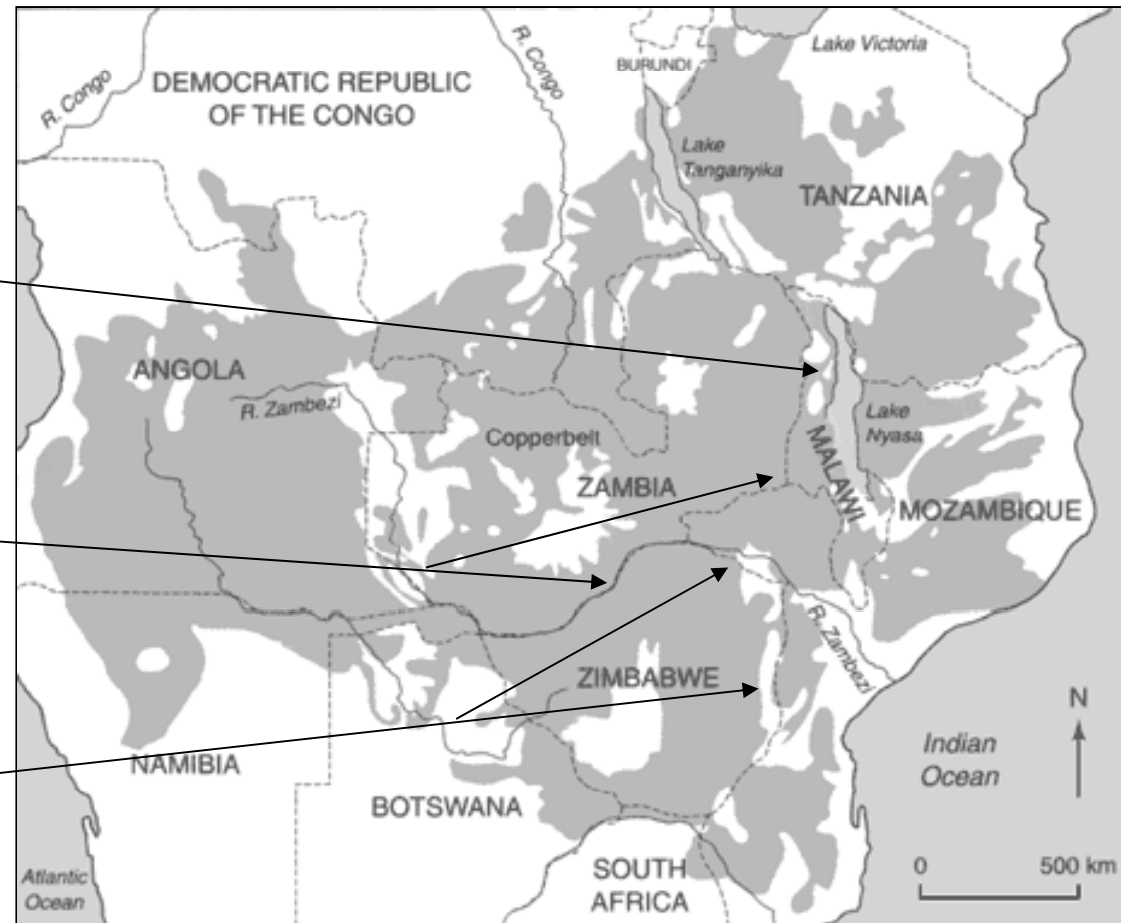
Implementation & Coordination of Agricultural Research & Training

The objectives of the ICART initiative were:

1. *LIVELIHOODS - to reduce the high level of rural poverty mainly by making agriculture more competitive to raise the poor farmers' income*
2. *CONSERVATION - to offset the high rate of natural resource degradation, with focus on soil, water and biodiversity*
3. *POLICY - to develop effective rural policy options, institutional and farmer organisations to support the agricultural production systems and to link the farmers to the market*

# Field Locations

- Malawi
  - Nchenachana
  - Champhira
- Zambia
  - Chipata
  - Choma
- Zimbabwe
  - Muzarabani
  - Nyanga

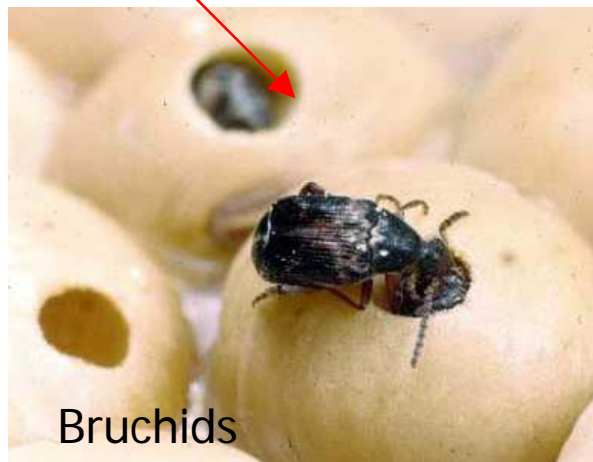


Caesalpinoid (Miombo)  
woodland zone



# AIM: Control of bean & cowpea pests using pesticidal plants

- *Maruca vitrata* larvae damage pods →
- Aphids transmit disease →
- Beetles damage stored product →
- Bean stem maggot →





# ADAPPT



A network for optimising & promoting indigenous botanical knowledge for food security and poverty alleviation in Africa

## Overall objectives

- strengthen S & T capacity of African programmes to exploit pesticidal plants
- optimise use of pesticidal plants for poor farmers.
- establish a research network: scientists to farmers.
- develop platform for marketable products





## OBJECTIVES of Funding Body - ACP S&T

Strengthen S&T capacity of ACP countries to support research, development and innovation in ACP region

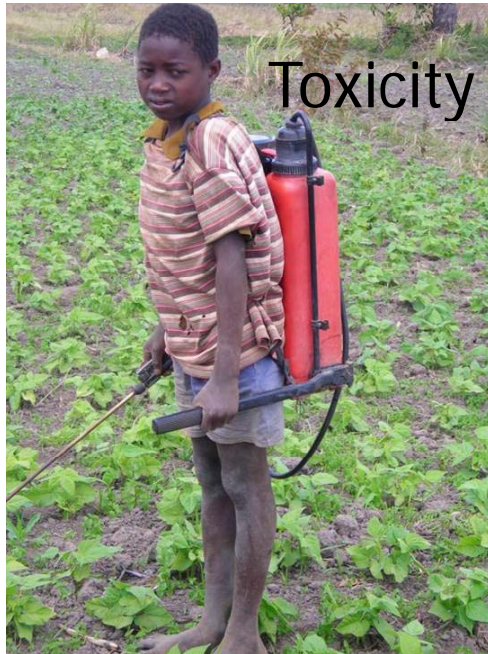
- *institutional, administrative & policy.*
- *academic research & technology.*
- *business & civil society.*

Promote interdisciplinary approaches to sustainable development along 3 axes:

- *Co-ordination & networking in applied research.*
- *Instruments for collaborative research.*
- *Management of research activities and reinforcement of research.*

# RATIONALE

- constraints of commercial pesticides



Labelling & Literacy



Waste dumping



Resistance

30% pesticides in developing countries below international standard  
– redundancy & adulteration



# Farmers have to use something





# Pesticidal plants

Unprocessed materials requiring rudimentary preparation - Highly suited to small scale farmers

Isman, 2008 *Ann Rev Entomol.*



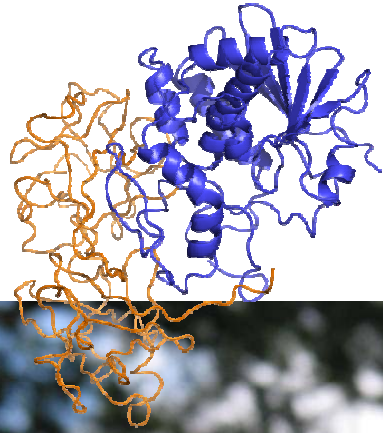
# Pesticidal plants

- Pesticidal plants appealing alternative - known quantity
  - Cannot be adulterated (if collected by farmer)
  - Cost effective (usually)
  - Toxicity & persistence is low
  - Selective activity
- But..
  - Efficacy can vary across seasons or locations
  - Application needs optimising.
  - Collecting takes time e.g. Scarce plants cost more
  - Huge quantities may be needed
    - Conservation consequences
    - Propagation required?





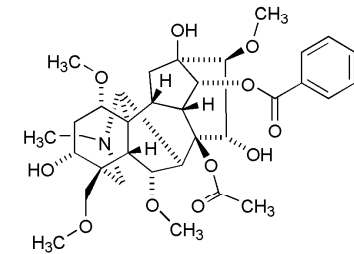
# Plants perceived as safe



Ricin  
ribosome  
inactivating  
protein (RIP)



*Aconitum* spp



*Ricinus communis*



# ADAPPT



## ■ *Overall objective*

- strengthen scientific & technological capacity of 7 countries
  - exploit pesticidal plants
  - optimise use by poor farmers
  - raise calibre of research – networks and good quality science
- establish network of scientists and agricultural technologists
  - NGOs
  - Agricultural government institutes
  - Universities
- develop & optimise cost effective insect control technologies based on pesticidal plant materials
  - field crops, stored product and livestock parasites
  - small-scale farming sector across African dry-lands.





# Outputs address ACP S&T objectives

- Output 1
  - African pesticidal plant network established
- Output 2
  - Capacity building through applied research
- Output 3
  - Ensuring sustainable use of target species
- Output 4
  - Production & marketing policy developed.
- Output 5
  - Communication & dissemination platform



# Output 1 Pan-African pesticidal plant research network established

- Inception meeting - Pretoria, South Africa Jan 2010
- Targets, action plans and network strategies

Zimbabwe



Zambia

Malawi



South Africa

Tanzania



Ghana

Pan-African



Kenya



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United Kingdom

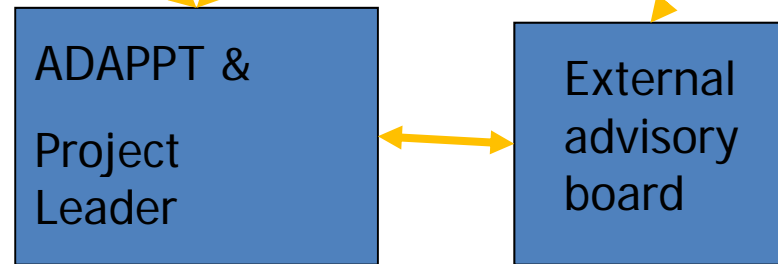
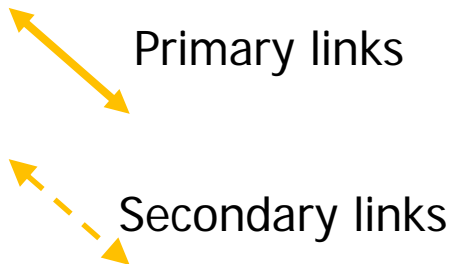
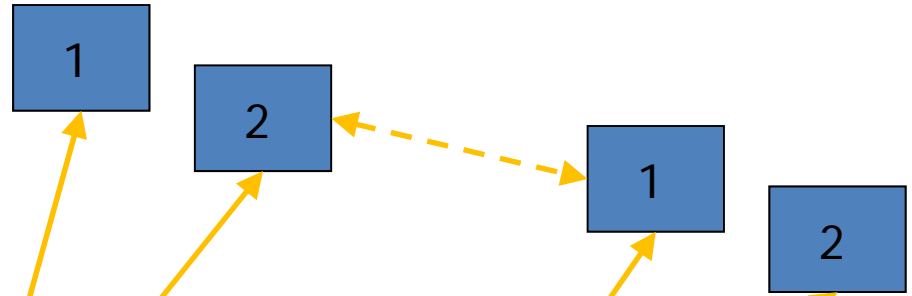




# ADAPPT Networking

7 Country networks  
30+ individuals/country

Country leaders





# Output 1 Pan-African pesticidal plant research network established

- National meetings held in 7 African countries
- Identify issues and feed info to ADAPPT network
  - Training priorities
  - Knowledge about local plant species
  - Complementary skills identified
  - New partnerships made
  - Technical limitations identified.

# Output 1 Pan-African pesticidal plant research network established

– New partnerships e.g.,

- 1 Sokoine University (Tanzania)  
NRI UK new pesticidal plants & residues on stored grain.
- 2 Copper Belt University (Zambia)  
RBG, Kew (UK) chemistry of non-timber woods for pest control
- 3 Egerton University (Kenya)  
University of British Columbia (Canada) on essential oils in pest control





# Output 1 Pan-African pesticidal plant research network established

## – Networking (and communication)

- Symposium on economically useful plants, Zambia *June 2010* – 150 delegates
  - 4 presentations by ADAPPT network
- McKnight foundation SACoP Maputo Oct 2011
- African Crop Science Soc. conference , Mozambique, *Oct 2011* – 500 delegates
  - Pesticidal Plant workshop hosted by ADAPPT - 50 participants
  - 8 presentations + 3 posters by ADAPPT partners
  - Identified key areas for research
    - » Optimisation
    - » Commercialisation
    - » Conservation





## Output 2 Capacity building & training and knowledge exchange

- Training of post graduate students
- Evaluation and analysis of pesticidal plant materials.
  - 1 MSc (Uni of Greenwich) student passed & returned to Ghana as University lecturer
  - 2 PhD students (Uni of Greenwich)
  - MSc students research at University of Zimbabwe, University of Zambia and Mzuzu University (Malawi).



MSc research at University of Zambia



# Output 2 Capacity building & training and knowledge exchange

- Training of post grads in micro-propagation - 14 participants
  - 3 day laboratory course - Zambia, Jan 2011.



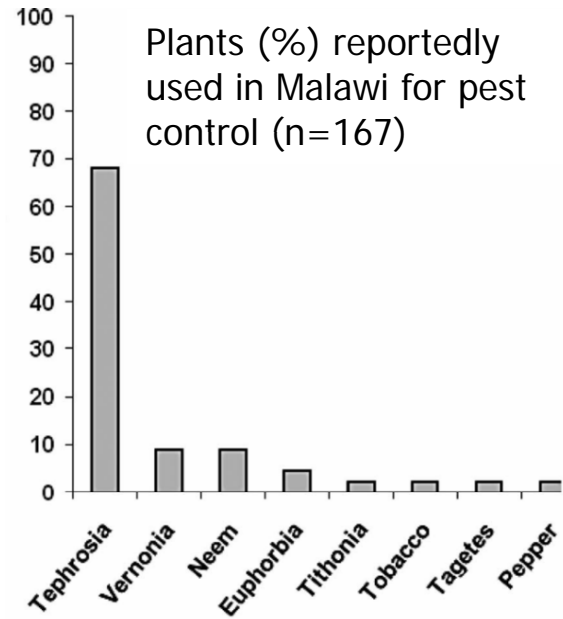




## Output 2 Capacity building & training and knowledge exchange

- Training for - 40+ participants in Zambia, Jan 2011.
  - Scientific writing
  - Biological evaluation of plant materials
  - Preparation of proposals for funding
    - 6 proposals written among network partners
- McKnight Foundation ●
- DeLPHE (British Council) ●
- CIFSR (Canadian Intl Food Security Res. Fund) ●
- PAEPARD (European Partnership in Agric Res and Dev) ●
- CSEF (Civil Society Environment Fund) ●
- BMGF (Grand Challenges Fund) ●
- Training to be repeated
  - Tanzania (Dec 2011)
  - Ghana (Jun-Dec 2012).

# Surveying analysis & biological evaluation pesticidal plant species – applied research training



- Validate activity
- Which chemicals active?
- Determine variations in efficacy/chemistry
- Optimise application

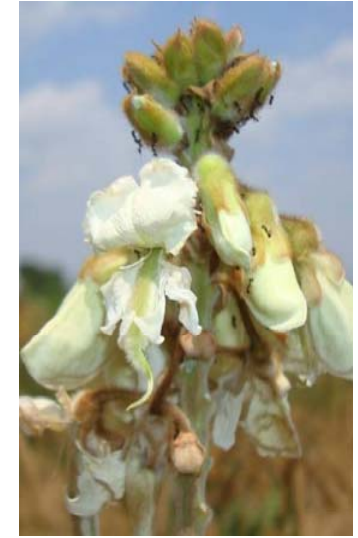
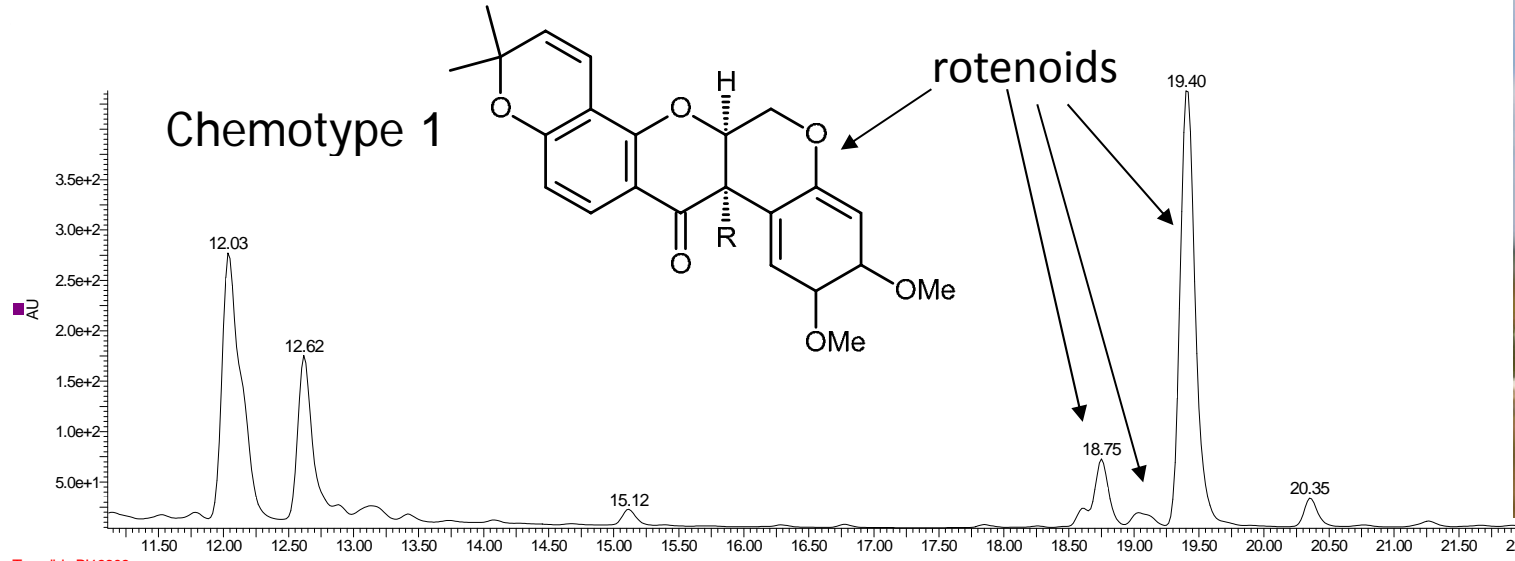
*Tephrosia vogelii*

Kamanula et al. 2011 *Intl. J Pest Manage*

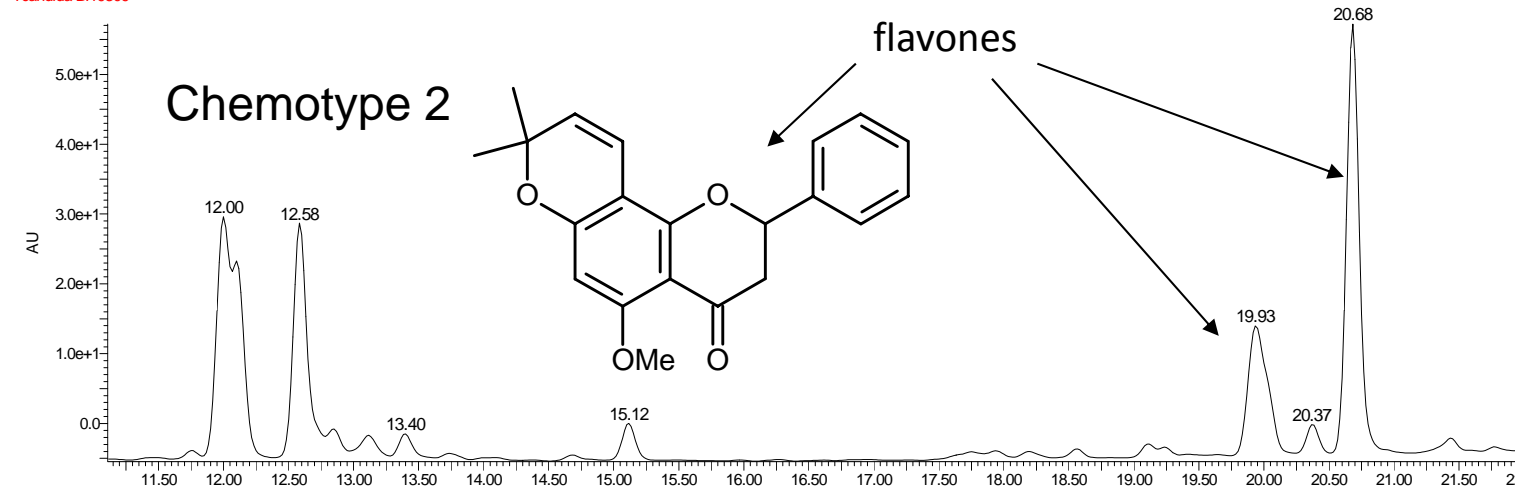
Nyirenda et al. 2011 *Afr. J Agr Res.*

# Chemical analysis of plant materials

Amount of compound



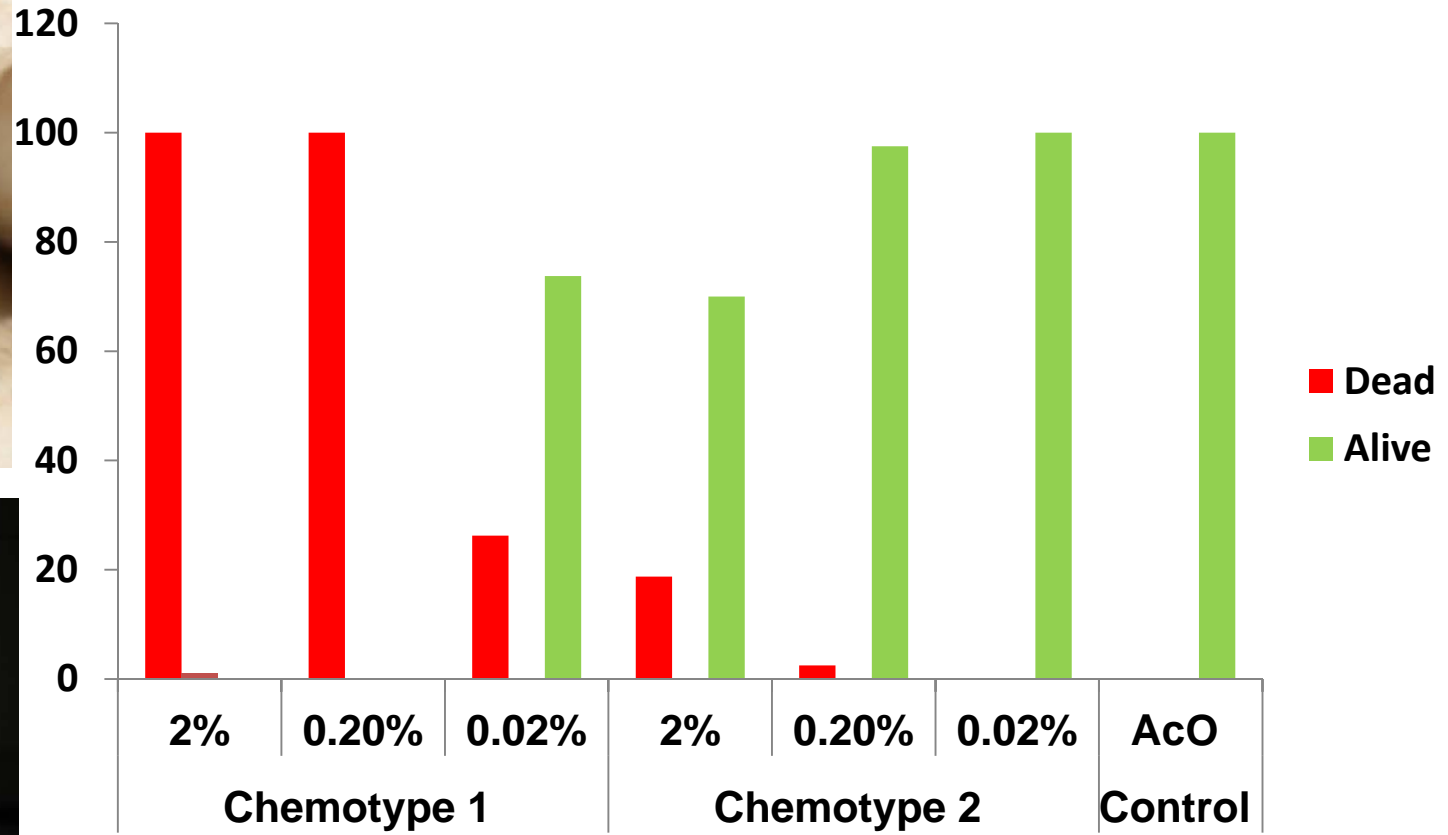
↑



→ time



# Biological evaluation and validation of plant materials



## Looking at practical implications



For field use - plants extracted in water  
& applied with a knap sack sprayer.  
But active compounds not soluble in water



# Field trials



Malawi  
Tanzania  
Zambia





Malawi  
Tanzania  
Zambia

# Output 3 Sustainable production of pesticidal plants



Thokozani et al., 2011 *Afr. J. Biotech*

Some useful plants are scarce & need cultivating but may have

- Low germination
- Slow seedling growth.
- Rapid loss of viability
  
- Propagation criteria developed for *some species*
  
- Harvesting protocols for plant species
  - SAFIRE handbook published on ADAPPT site [www.nri.org/adappt](http://www.nri.org/adappt)

# Output 3 Sustainable production of pesticidal plants

Optimising conditions for propagation



can we produce roots that can be planted out directly for transfer to farmers



# Output 4 Production and marketing of pesticidal plants

– Policy recommendations via desk study – looking at

- Best practices & case studies
- Farmer production
- Marketing networks
- Marketing hurdles
- Bio-safety issues
- Product Registration.



# Output 4 Production and marketing of pesticidal plants

## Example outcomes

- variation in efficacy problematic – quality control needed before up-scaling
- opportunity for wide-scale promotion as commercial products for local use by SMEs unexploited - why?
- Can selling of PPs be formalised without changes to regulatory hurdles or within current



# Output 4 Production and marketing of pesticidal plants

- Way forward needed.
  - framework to enable production and commercialisation of PPs
  - registration process needs to be understood - but providing data and information is expensive
  - raw material supply remains a challenge
  - investment in development, promotion and awareness raising needed







## Output 5 Communication & dissemination platform for pesticidal plant knowledge

- Papers published in international journals
- Attendance of scientific symposia
- International conference planned for Year 3
  - Proceedings to be published in a special issue of *Crop Protection & Biopesticides International*.
- ADAPPT network website [www.nri.org/adappt](http://www.nri.org/adappt)
  - Information bulletins
  - policy briefs
  - plant database



# The First International Conference on Pesticidal Plants

18-21 February 2013, ICIPE, Kenya



**Harnessing pesticidal plant technologies for  
improved livelihoods**



18<sup>th</sup> – 21<sup>st</sup> February 2013 at ICIPE,  
Further announcements

[www.nri.org/adappt](http://www.nri.org/adappt)

[www.facebook.com/pesticidalplantsconference](http://www.facebook.com/pesticidalplantsconference)





# African Dryland Alliance for Pesticidal Plant Technologies:

A network for optimising and promoting the use of indigenous botanical knowledge for food security and poverty alleviation in Africa



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## What is ADAPPT?

ADAPPT is a project supported by a European Union grant through the [ACP Science and Technology Programme](#) to establish a network of scientists and agricultural technicians, from NGOs, agricultural institutes, ministries and universities from Ghana, Kenya, Malawi, Namibia, South Africa, Tanzania, Zambia, Zimbabwe and the United Kingdom with a focus on pesticidal plants\* as environmentally benign and safer alternatives to synthetic pesticides. The specific partners are listed on the [Partners](#) page of this website. ADAPPT will:

1. Establish an intra-African network with linkages to international networks,
2. Build capacity to assess research needs to facilitate the formulation and implementation of research policies associated with pesticidal plants and to prepare and submit project proposals for new funding opportunities, and
3. Enhance the research capacity and incentive of the network partners and so increase the quality and impact of research results and disseminated outputs.

This action will address [Millennium Development Goals](#) 1, 7 and 8 by targeting poverty eradication at the small-scale farming level, building and enhancing strong scientific and technological capacity in agriculture, chemistry, biodiversity conservation, and plant physiology. This will support research, development and innovation in the ACP region, and enable the identification and formulation of activities or policies that are critical to sustainable development related to habitat conservation, pesticide regulations, indigenous knowledge and implementing the [UN Convention on Biological Diversity](#).





Publications  
Links  
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The list below is a subset of pesticidal plants that have been the subject of research of ADAPPT partners. Further details about each plant can be found by clicking on the highlighted Latin names of the plant species listed.



[Tephrosia vogelii](#)



[Azadiracta indica](#)



[Securidaca longepedunculata](#)



[Euphorbia tirucalli](#)



[Tithonia diversifolia](#)



[Vernonia amygdalina](#)



[Melia azedarach](#)



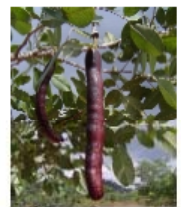
[Dolichos kilimandscharicus](#)



[Solanum panduriforme](#)



[Tagetes minuta](#)



[Robaunnia madagascariensis](#)

ADAPPT - African Dryland Alliance for Pesticidal Plant Technologies - Windows Internet Explorer

http://www.nri.org/projects/adappt/Tephrosia\_vogelii.htm

fantasy premier league

File Edit View Favorites Tools Help

Platform Database Phil Stevenson - Out... BBC News - Home nri ADAPPT - Africa... Home Feeds (1) Print Page Tools Help Research

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## Tephrosia vogelii (Vogel's Tephrosia)

### Leguminosae

#### General

[Tephrosia vogelii fact sheet](#) (ICRAF)

ADAPPT fact sheet - under revision

*T. vogelii* is probably introduced and not native anywhere in Africa. It is widespread in tropical Africa from Sierra Leone and Ethiopia southwards to Angola, the Flora Zambesiaca area and the Comoro Islands; also from Assam to Indonesia. The species has been extensively cultivated and found near cultivated land for use as a fish poison and is clearly introduced in many of its present localities so that the extent of its native area is now obscured. It is a shrubby plant used as a fallow plant to improve soil fertility and to reduce erosion, particularly in higher areas. A related species, *T. candida* is widespread in parts of Asia, e.g. in Vietnam where it is used as a green manure and cover crop. *Tephrosia* spp. may grow as rapidly as 2-3 metres in 7 months. *T. vogelii*, after 5 months of growth, produces about 27-50 tonnes of green material per hectare. This is equivalent to about 110 kg of nitrogen. Plants can be planted as a hedgerow at a distance of 1 metre. Leaves of *T. vogelii* contain at least 4 insecticidal compounds collectively known as rotenoids. It has been reported that the mature leaves of *T. vogelii* contain 80-90% rotenoids. In other *Tephrosia* species, flavonoid compounds are found and these are also known to have profound effects on insect development and behaviour. The highest concentration of the active compounds are found in the leaves.

It is a shrub 1-3(4) m high, usually much branched and bushy. Stems brown tomentose with long flexuous hairs intermixed among shorter and denser spreading hairs. Leaves with (6)8-13(15) pairs of leaflets; petiole 0-28 mm long, petiole and rachis together (0)11-22(27) cm long, tomentose like the stem; leaflets 2.5-5.5(7.5) × (0.6)0.9-1.7(2.3) cm, elliptic-oblong to oblanceolate, rounded to cuneate at the base, rounded to emarginate at the apex, slightly mucronate, the upper surface rather thinly appressed-pubescent, the lower surface densely appressed-pubescent; stipules 11-20 × 2.5-4.5 mm, narrowly triangular or sometimes markedly falcate, soon falling. Flowers in dense heads up to 10(20 in fruit) cm, or the lowermost sometimes somewhat remote; bracts up to 16 × 13 mm, broadly ovate-acuminate to suborbicular-acuminate, brown or greyish tomentose, conspicuous at bud stage but soon falling as flowers open; pedicels 14-26 mm long, brown tomentose. Calyx 14-20(24) mm long, brown or greyish tomentose; upper and lateral teeth about twice as long as the tube, oblong, ± truncate at the apex, the lower tooth about 1.5 times as long as the lateral, strongly grooved and upwardly curved distally into a keel-like shape. Petals white, rarely the standard purple; standard 24-30(34) mm long, truncate to strongly cordate at the base, the wings and keel petals somewhat shorter. Upper stamen loosely attached to, and easily detachable from, the adjacent stamens about the middle of the filament. Ovary tomentose; style pubescent. Pods 9-14.5 × 1.3-1.7 cm, light brown lanate-tomentose. Seeds numerous (more than 15), 6-8 × 4-4.5 × 2-2.5 mm, black, smooth, with a well developed white U-shaped aril c.2 mm long.

#### Plant parts with insect-controlling properties

leaves, roots

#### Mode of action

Antifeedant, insecticidal, acaricidal, ovicidal, fish poison  
Contact and stomach poison

#### Target organisms

a range of field pests and for general stored product protection

#### Preparation and application

Take fresh leaves of *Tephrosia vogelii* and dry them. Grind the dried leaves into a powder. Mix 100 g of powder with 100 kg of maize to control maize weevils and the larger grain borer. In beans it can control bean bruchids. The control effect lasts about 3 months. After that time new *Tephrosia* powder has to be added.

Done

Internet 100%

Start In... Sk... U... D... F... Sc... F... AD... RE... Dr... A... ad... 18:08

# Map of ISP locations accessing the ADAPPT website

adappt (Recent Visitor Map)

23rd November 2010 09:10:03



Map data ©2010 Geocentre Consulting, MapLink, Tele Atlas, Whereis(R), Sensis Pty Ltd.





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## Science News

Blog Cite Save

### Natural Pesticide Protects Cattle Against Ticks in Africa

ScienceDaily (Oct. 11, 2011) — Cattle are extremely vulnerable to ticks, mites and flies which can transmit blood parasites, cause irritating wounds and then infections. In order to control them farmers must dip their cattle in a pesticide. This is impractical and expensive for poor farmers with just a small number of livestock.

#### See Also:

##### Plants & Animals

- Agriculture and Food
- Seeds
- Endangered Plants
- Botany
- Spiders and Ticks
- Pests and Parasites

##### Reference

- Organic farming methods
- Sustainable

A solution may lie in the perennial plant, *Lippia javanica*, widely consumed to alleviate symptoms of fever is also used by some farmers to make a pesticide. The University of Greenwich team in collaboration with the University of Zimbabwe, pulped and soaked the *Lippia* leaves in water to produce an extract which could be sprayed on cattle. Varying concentrations were tried to discover the best application method and the level of protection provided by the plant extract.



Cattle in Southwest Ethiopia. (Credit: Steve Torr, University of Greenwich)

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#### Bed Bug Eradical

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# Monitoring and Evaluation

- External Advisory Board
  - Prof. Murray Isman
    - Dean, University of British Columbia, Canada
  - Prof. Ahmed Hassanali
    - Professor of Chemistry, Kenyatta University, Kenya
  - Prof. Opendar Koul
    - Director, Koul Foundation, India
- Statistical analysis and research methods
  - Dr. Stephen Young (University of Greenwich)





# Monitoring and Evaluation

- Publications - peer review -
- Project target = 10 peer reviewed papers
- Current output
  - 8 papers on pesticidal plants
  - 6 more in prep
- Stevenson et al., 2011 *Tetrahedron Letters*, 51: 4727–4730.
- Kamanula et al., 2011 *International Journal of Pest Management*. 57: 41-49.
- Thokozani, et al., 2011 *African Journal of Biotechnology* 10: 5959-5966.
- Madzimure et al., 2011 *Tropical Animal Health & Production*, 43: 481-489
- Nyirenda et al., 2011 *African Journal of Agricultural Research*, 6: 1525-1537.
- Sarasan et al. 2011. *Plant Cell Reports*, 30:1163–1172.
- Zulu et al., 2011, *African Journal of Biotechnology* 10: 5988-5992.
- Stevenson et al. (in press), *Biopesticides Intl.*





**Thank You**

