The SAPP Project
Southern African Pesticidal Plants

Natural Resources Institute

The SAPP Project

Optimising the use of Southern African Pesticidal Plants

- Dr. Philip C Stevenson
- *Natural Resources Institute, University of Greenwich,*
- *Chatham, Kent, UK. (Lead Institute).*

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Partnership

- *University of Zimbabwe.*
- *DARS, Mzuzu, Malawi.*
- *ICRAF, Malawi.*
- *Mzuzu University, Malawi*
- *SAFIRE, Zim & Zambia.*
- *Royal Botanic Gardens, Kew, UK*

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World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

SAFIRE

Kew
PLANTS PEOPLE POSSIBILITIES

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The objectives of the ICART-CRARF initiative to:

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

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Project Aims

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- Optimise application, harvesting and H & S of pesticidal plants — Livelihoods
  - Improving pest management
- Database of knowledge about distribution, habitats & harvesting — Conservation
  - Promote conservation across the region.
- Cultivate & strengthen market potential — Policy and Markets
  - Private sector
- Capacity building in SADC — All 3
  - Training of SADC scientists and technicians
  - Exchange visits to UK & other SADC countries.

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Rationale

- Arthropods important biotic constraint in
  - Crop production
  - Storage
  - Livestock
- Pest control is often essential
- Commercial Pesticide or Pesticidal Plants

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Commercial Pesticides - Problems

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- Poor efficacy
  - Adulterated products
  - Restricted availability
  - Pesticide resistance
  - Incorrect application
- Human health & safety
  - Applicators
  - Consumers
  - Chronic & acute
- Environmental impact
  - Pollinators
  - Biological control
  - Wildlife
- Cost
  - Actellic SuperDust ~10% value of product

Endosulphan instructions for use and H & S guidance

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Pesticidal plants

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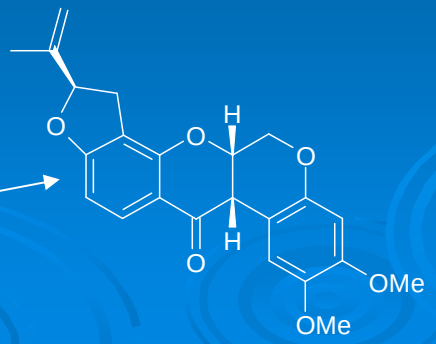
- Fruit, leaves, bark, root etc.
- Low cost
  - Harvesting and prep takes time
- Less harmful
  - People & environment
- Effectively reduce
  - Crop damage, stored product losses & livestock parasites
- Plants not perfect
  - Variable efficacy
  - Large quantities needed
  - Toxicity – e.g., rotenone



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SAPP PROJECT WORK PACKAGES
Each coordinated by different partner

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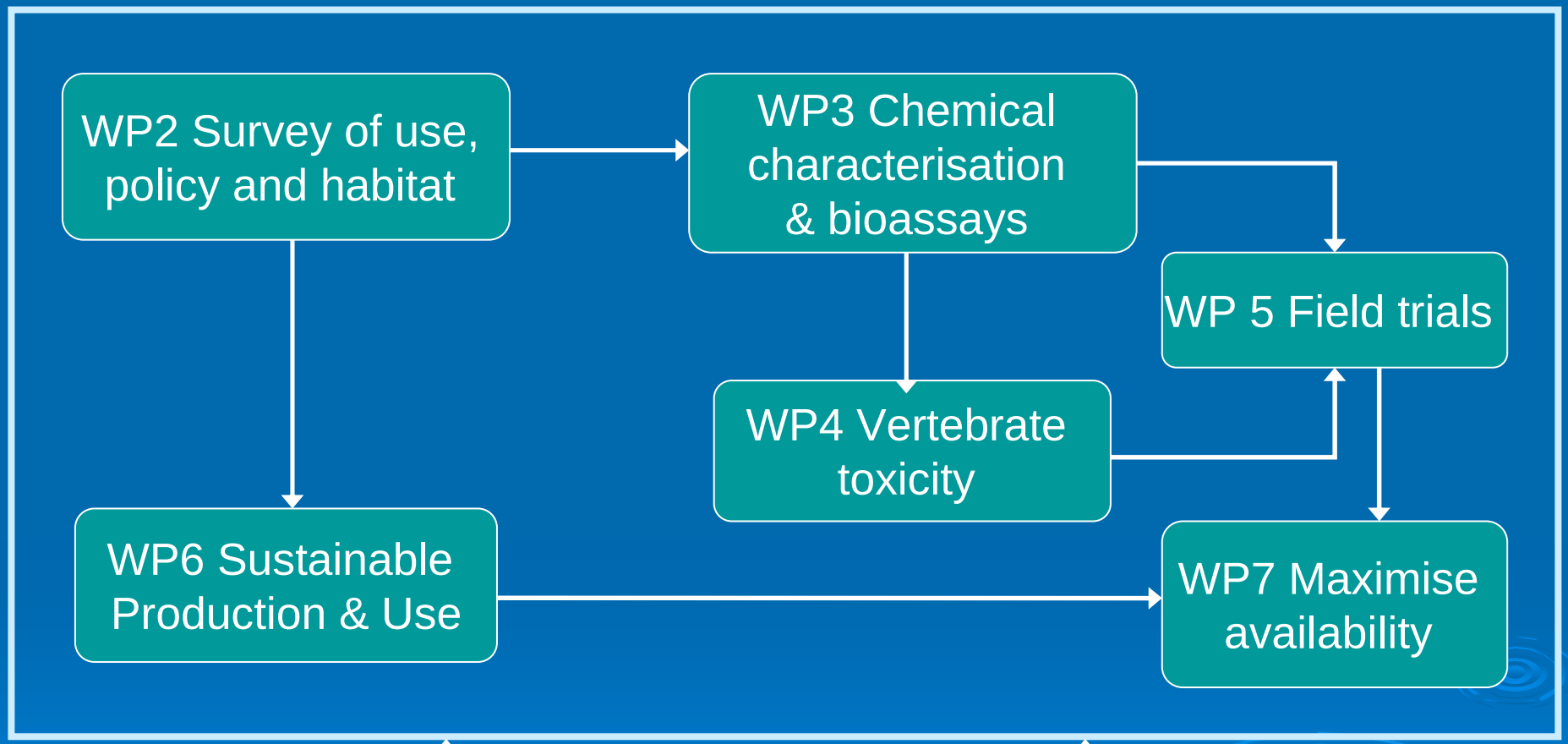

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Field Locations

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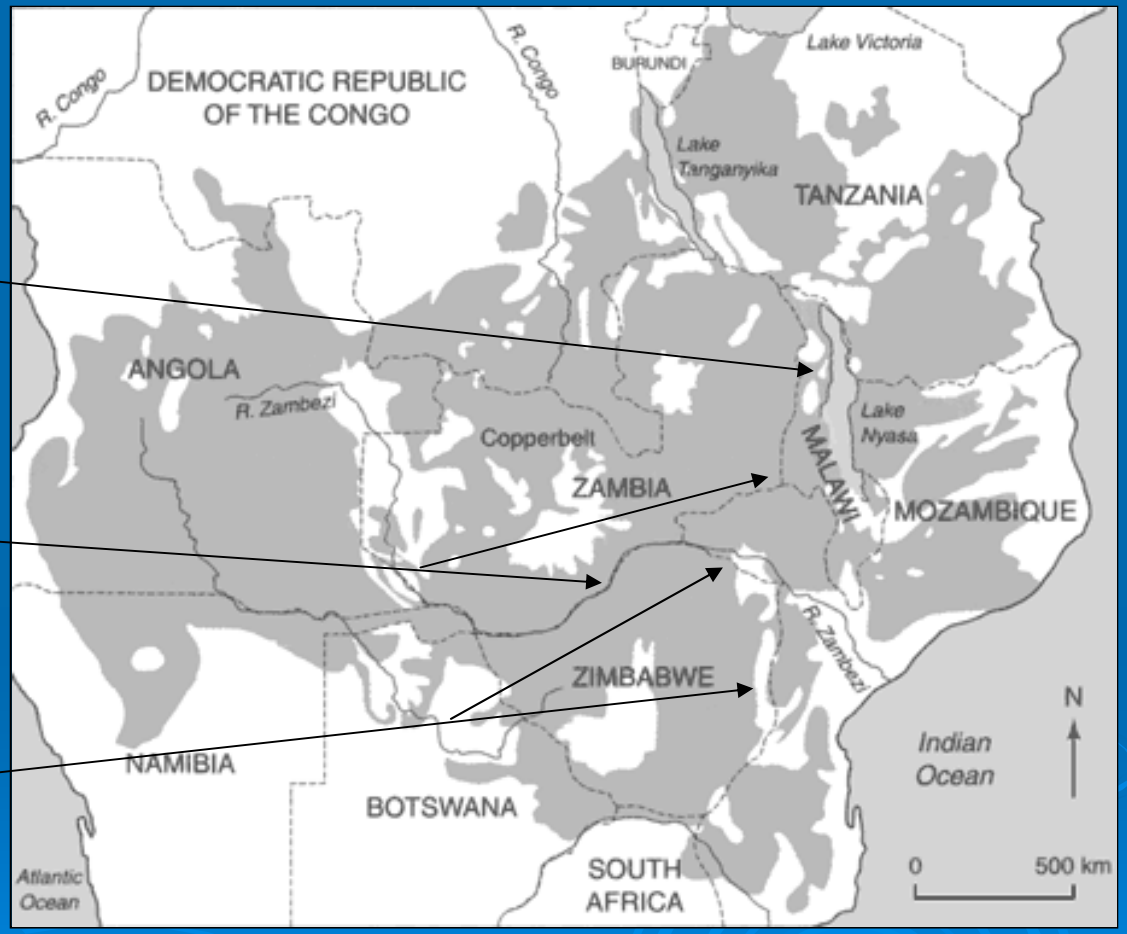
- Malawi
  - Nchenachana
  - Champhira
- Zambia
  - Choma
  - Chipata
- Zimbabwe
  - Muzarabani
  - Nyanga



Caesalpinioid (Miombo) woodland zone

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Miombo woodland

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- Caesalpinioid legume trees
  - *Brachystegia* spp. (Miombo)
  - *Colophospermum mopane*
  - *Baikiaea plurijuga*

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Surveys Of Use & Distribution

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- Surveyed
  - pesticidal plant use
  - major pest problems

  >500 farmers interviewed in 6 locations

Engaging with farmers & empowering

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Surveys Of Use & Distribution

Natural Resources Institute

- ~100 plant species of known value
  - Priority species list
    - *Aloe ferox*
    - *Bobgunnia madagascariensis*
    - *Dolichos kilimandsharicus*
    - *Euphorbia* (spp.)
    - *Lippia javanica*
    - *Neorautanenia mitis*
    - *Solanum panduriforme*
    - *Securidaca longepedunculata*
    - *Strychnos spinosa*
    - *Tephrosia vogelii/candida*
    - *Vernonia* (spp.)
    - *Mucuna pruriens*
  - Non-indigenous species
    - *Tithonia diversifolia*,
    - *Azadirachta indica* – Neem.
    - *Tagetes minuta*
    - *Cymbopogon* spp.

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Surveys of Use Outcomes & Visibility

- Pesticidal plant information sheets (village posters?)
  - For farmers & extension workers
- Policy document on economic importance of pesticidal plants especially from Miombo woodlands
  - Conservation priorities & incentives
  - Small enterprise opportunities
- Database on distribution & optimised uses of plants
- Available Dec 2009 SAPP website www.nri.org/sapp

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THE SOUTHERN AFRICAN PESTICIDAL PLANTS PROJECT

Caesalpinioid Woodlands of Southern Africa: Optimising the Indigenous Use of Pesticidal Plants

This project seeks to improve the livelihoods of farmers in Southern Africa by enhancing the use of pesticidal plants. This involves:

- Optimising safe & low cost pesticidal plant use for small-scale farmers in Southern Africa;
- habitat conservation – improving collection, cultivation & safe application of pesticidal plants;
- influencing policy & strengthening market potential for pesticidal plants in compliance with the Convention on Biological Diversity (CBD);
- building scientific capacity in southern partner institutions through training and exchange visits.

This project considers pesticidal plants (a.k.a. botanical pesticides, ethno botanicals) to be all plant materials (e.g., roots, leaves, seeds, flowers etc.) that require only rudimentary preparation (e.g., powdered, water extracted) which farmers can use to reduce field crop damage, stored product losses and livestock mortality/morbidity.

The SAPP project is funded by the Implementation and Coordination of Agricultural Research and Training (ICART) Programme of the Southern African Development Community (SADC) Region.

It brings together University, NGO and government partners from Malawi, Zambia, Zimbabwe and the UK.

Spraying synthetic pesticides is rarely carried out wearing the correct protective clothing. *Photo S. Nyirenda.*

http://www.nri.org/sapp

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Visibility - worldwide

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Farm trials & PRA

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- Validation of pesticidal plants
  - Farmer PRA of plants
  - Substantiate survey data
- Promotion of concept
- Engage with farmers
  - Facilitate adoption of optimised use
  - Provide information exchange forums
  - Enhance widespread knowledge base

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Target pests

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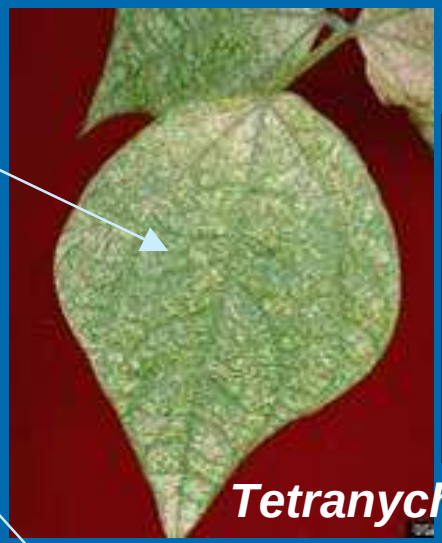
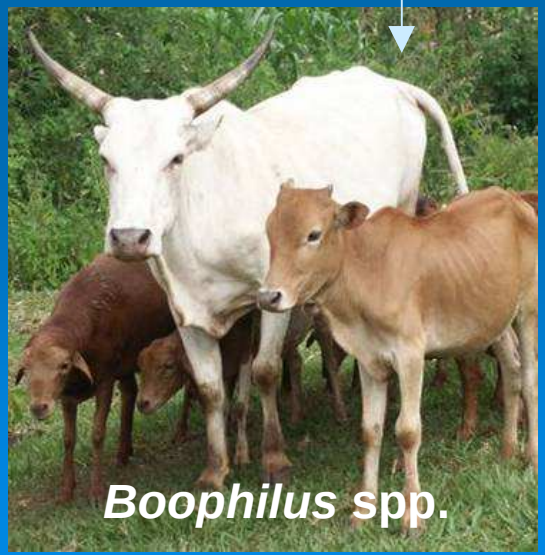
- Spider Mites damage field crop
- Aphids also transmit disease
- Weevils damage stored grain
- Ticks spread disease



Tetranychus davidii



***Boophilus* spp.**

Sitophilus* spp & *Prostephanus truncatus

Brivocoryne brassicae

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Choma –Zambia

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Nachibanga ward

1128 households (pop'n. 7584)

200 households adopting pesticidal plants under SAPP

PRA with 36 farmers at 5 sites
4 treatments
1 commercial pesticide
1 untreated

Plant material admix @ 2% w/w

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PRA of pesticidal plants

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Farmers ranking

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Ranked according to effect.

1. Actelic Superdust (Commercial product)
2. *Securidaca longepedunculata* (Mupama)
3. *Euphorbia* spp. (Namanunga)
4. Control (Untreated)
5. *Bobgunnia madagascariensis* (Muyongolo) **
6. *Cassia abbreviata* (Mululuwe)

**Validation of plants is critical.

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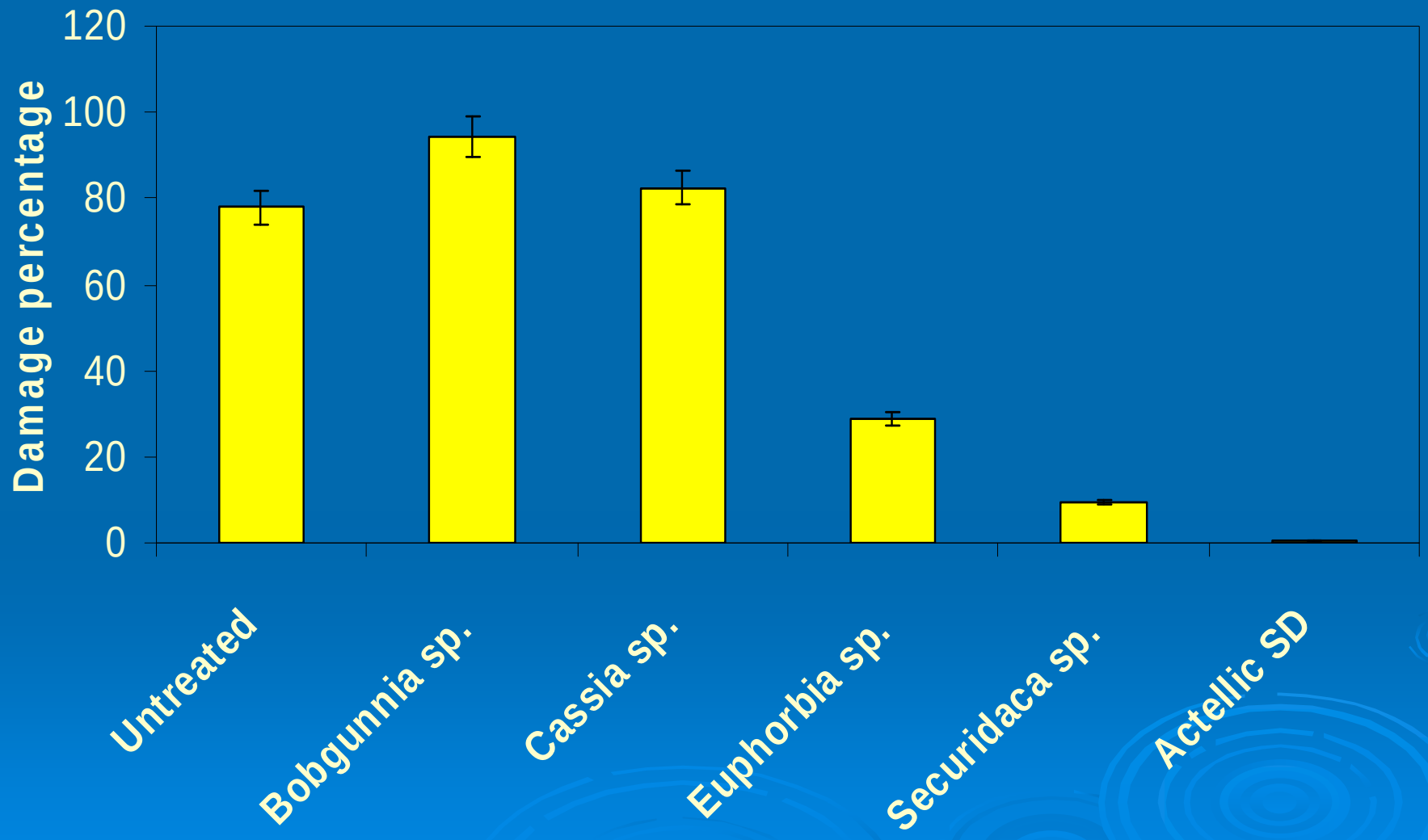
Lab evaluation of maize damage by *Sitophilus zeamais* after 20 week



2 X BSc student projects – SAFIRE supervision at University of Zambia

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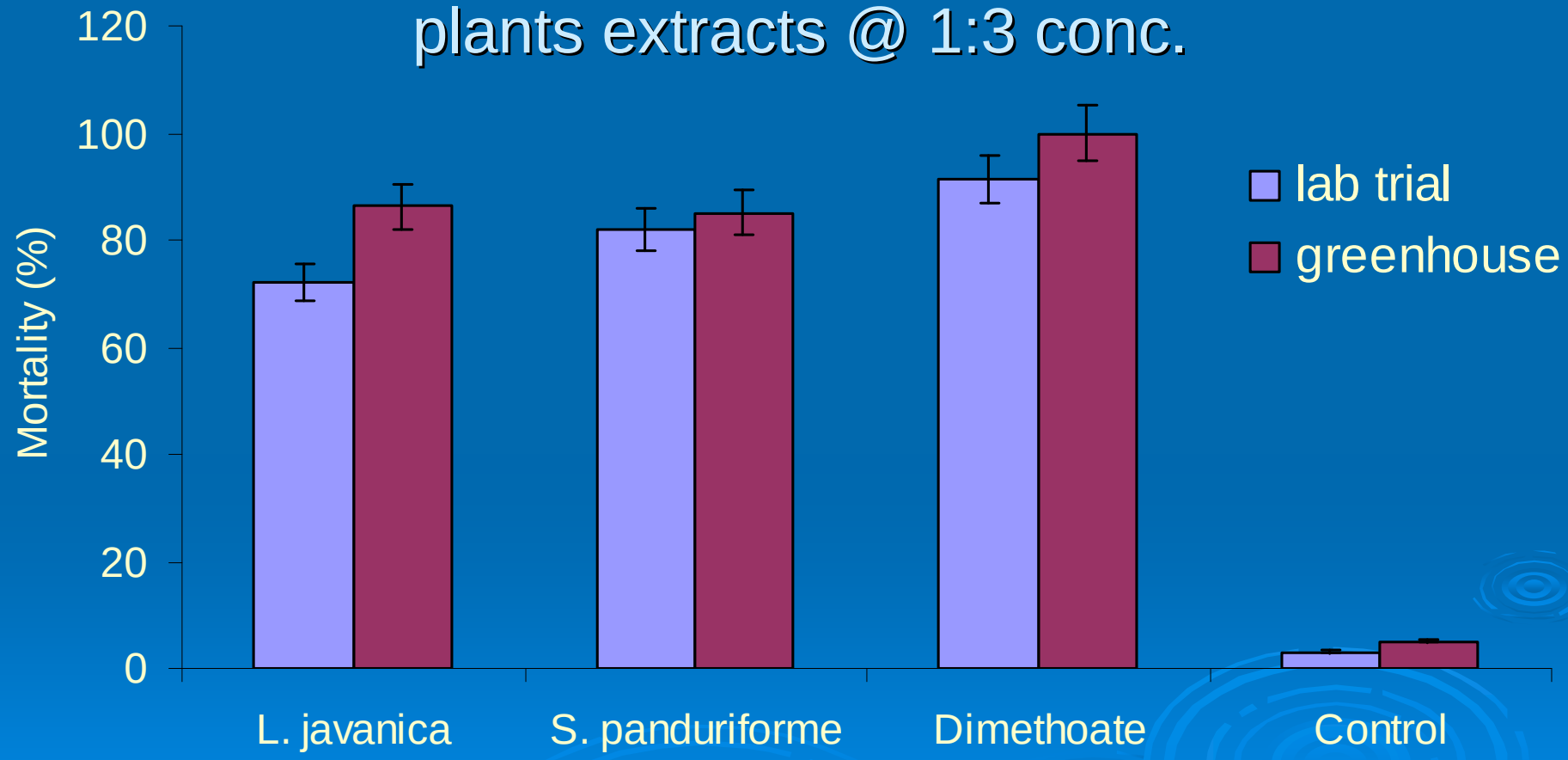
Aphid mortality on rape 72 h after spraying with plants extracts @ 1:3 conc.



– MSc student projects –at University of Zimbabwe

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Station trials - cattle

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- Tickbuster®
  - effective control of ticks.
- Station trials show
  Solanum panduriforme (5%)
  Strychnos spinosa (10%)
  effective alternatives.
- But potential toxicity to mammals/humans so ideally avoided

MSc student project; Uni of Zim

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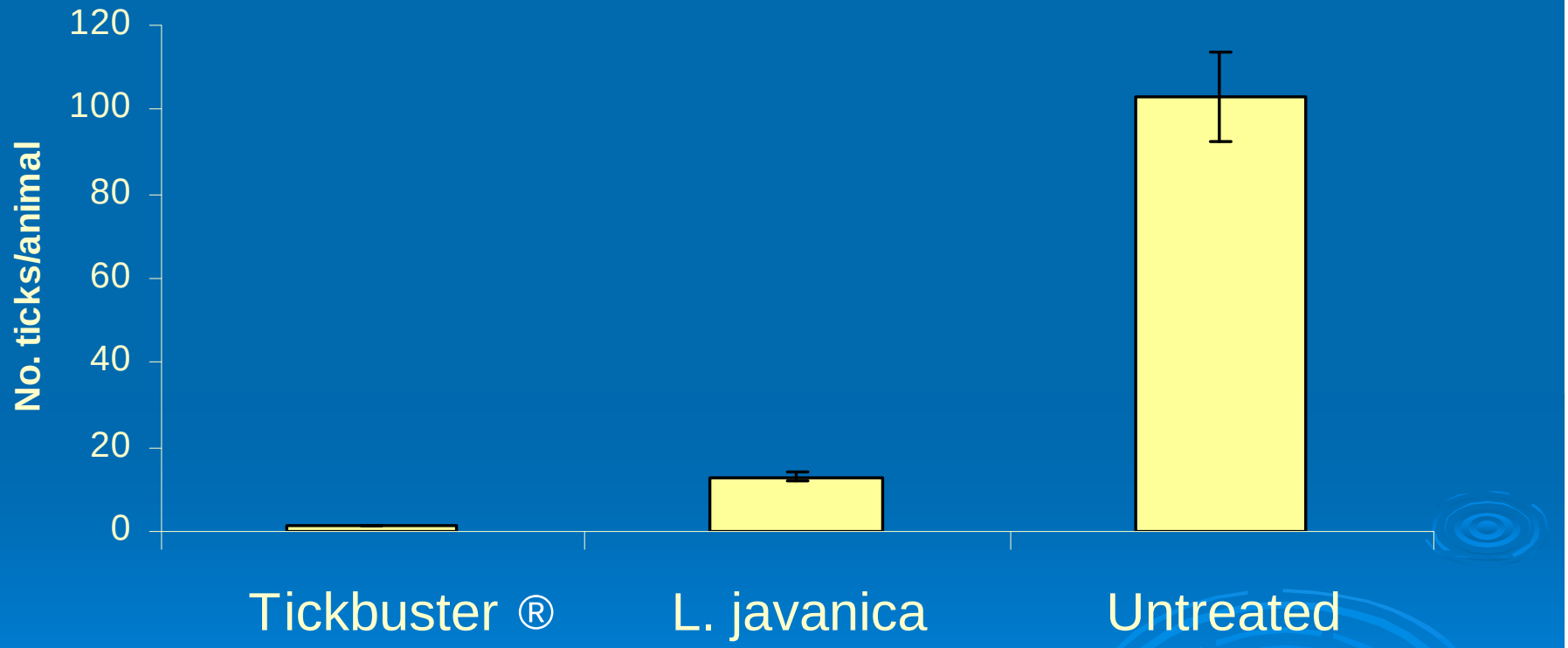
Effect on tick count / animal of treating cattle with 5% *Lippia javanica*



MSc student project; University of Zimbabwe.
PhD research of SAPP partner on chemistry, University of Mzuzu

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Chemical Analysis & Bioassays

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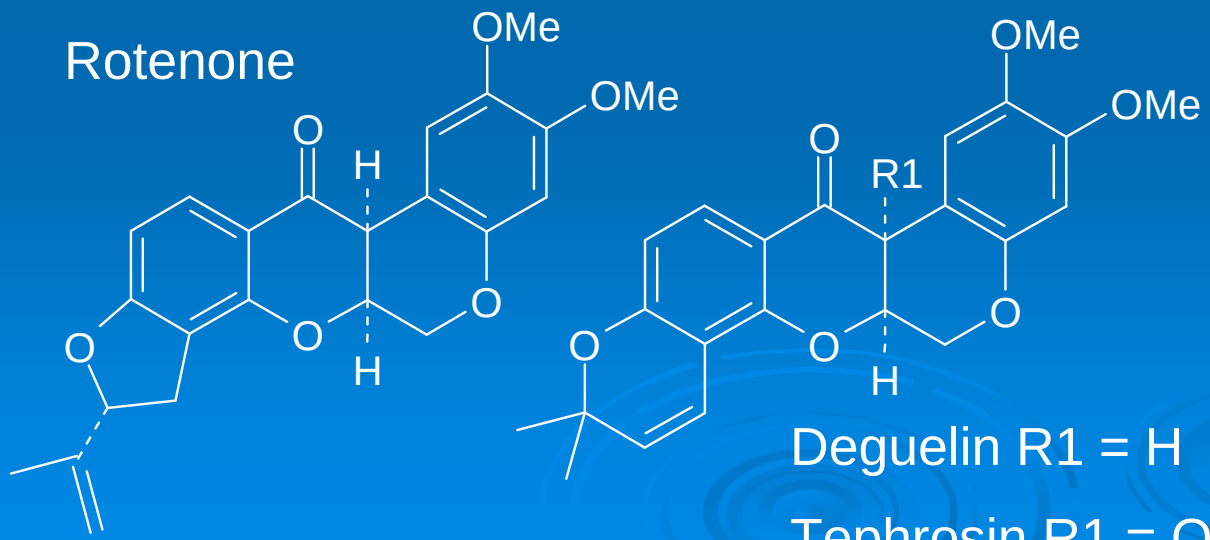
- Validation needed
- Assumptions about occurrence of rotenone.
- Rotenone absent from *Tephrosia*
- Are tephrosin & deguelin active?
- What determines occurrence of rotenoids?

Tephrosia vogelii

most reported plant

Rotenone



Deguelin R1 = H

Tephrosin R1 = OH

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Securidaca longepedunculata

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- Effective stored product protectant
  - Ghana & Zambia.
- Root bark pounded & mixed with grain
  - inefficient

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Securidaca longepedunculata

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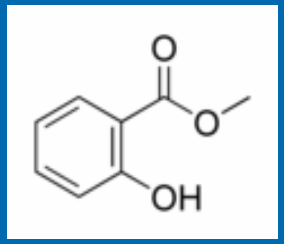
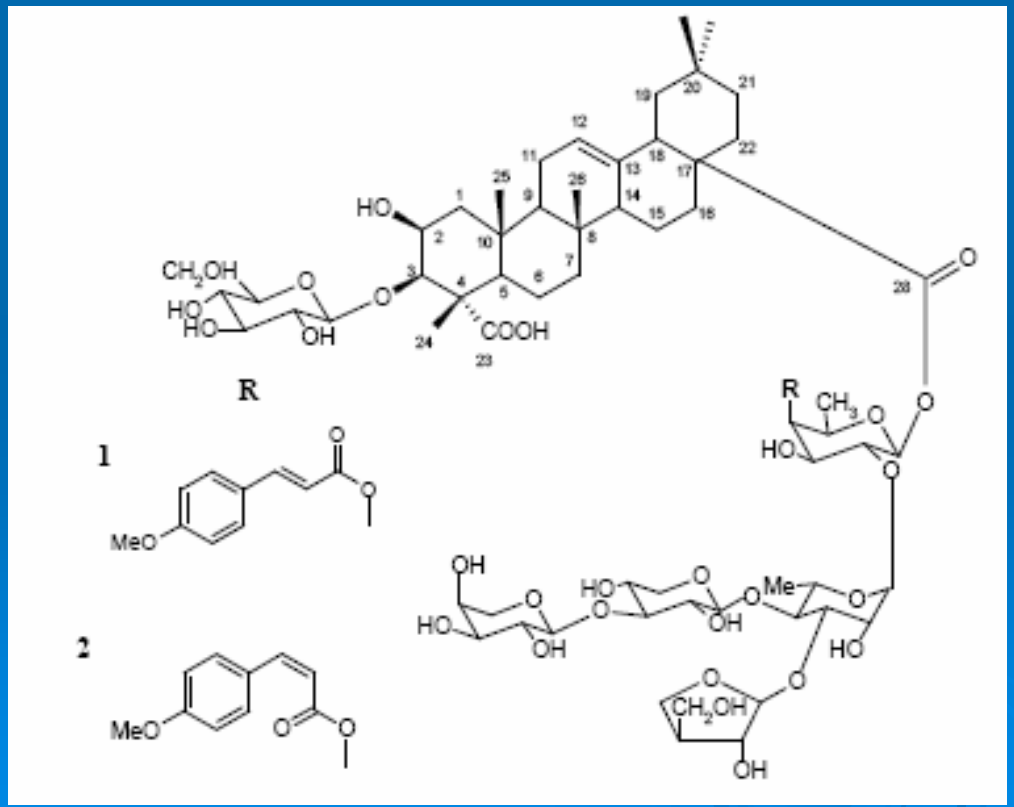
- Methylsalicylate
- Saponins





- Deterrent & toxic to pest
  But volatile
- Short lived effect
- Saponins also active
- Occur in stem bark
- Can stem bark be used instead of root
  - sustainable

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Water extracts saponins & is more efficient use of plant

Every grain coated – saponins act as surfactant

Submersion of grain during treatment & solarisation kills pre-storage infestation.

Extracting *Securidaca* and treating grain

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Mucuna pruriens

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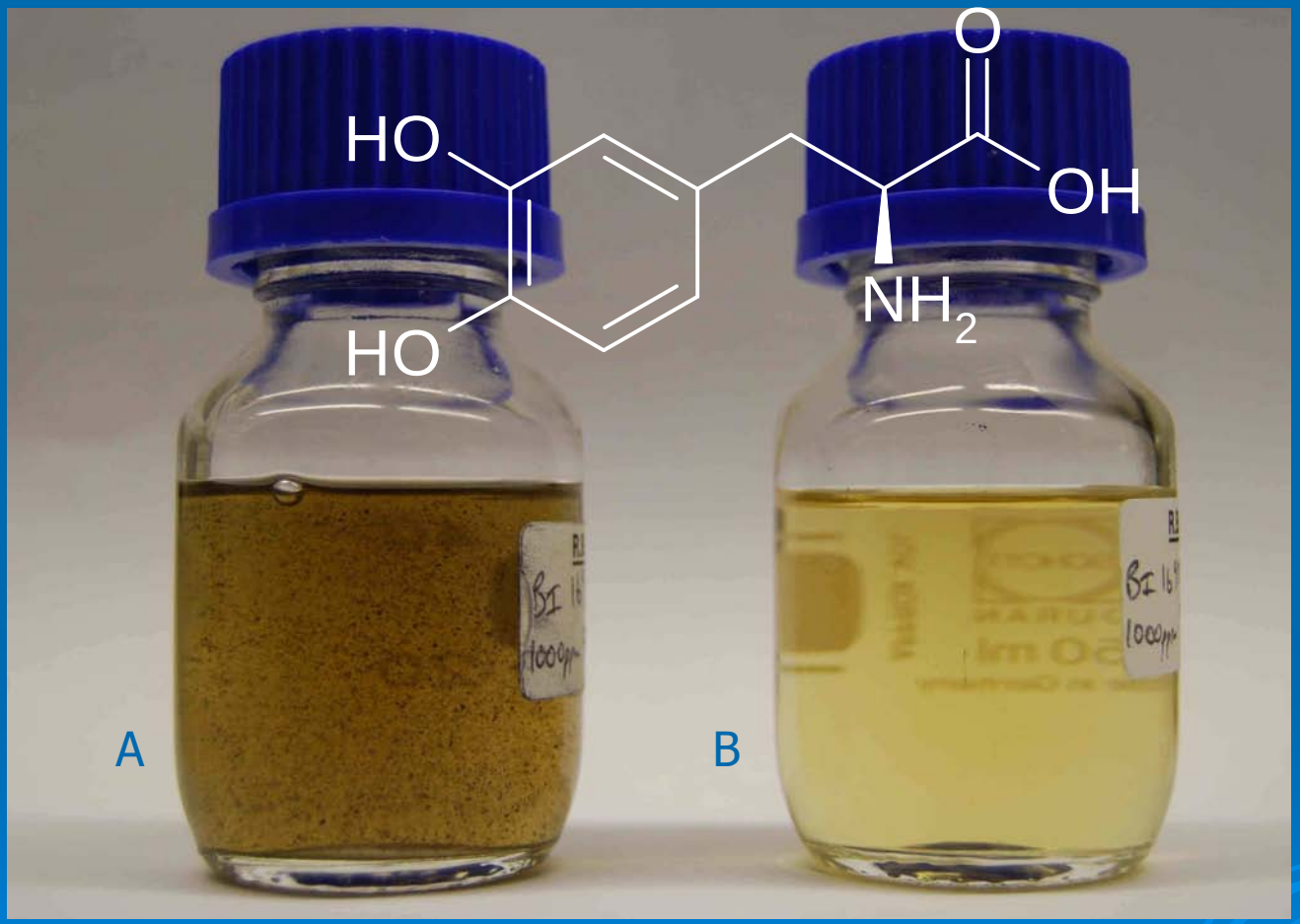

L-dopa forms polymers.

So extract sprayed immediately

Or stored in vinegar

Mucuna pruriens seed coat extracted in 70% MeOH.

A = 70% MeOH B is 2% acetic acid in 70% MeOH.

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Effect of plant species extracts on *Spodoptera litorralis*

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Species or sample	Feeding Index	Devel effect %	Mortality 2nd inst.	Mortality 4th inst.
S. longepedunculata stembark	88.7(7.52)**	37*	55*	45*
Dolichos kilimandscharicus	-45.7(5.9)	83	40*	35*
Solanum panduriforme	-53.4(12.92)	88	50*	30*
Entada rheedei pods	-45.2(9.38)	82	50*	45*
Euphorbia tirucali	-64.7(11.48)	77	55*	40*
Neem seed kernel MeOH	100(0.0)**	18**	100**	75**
Neem seed kernel Decon 90	85.8(5.81)**	19**	100**	75**
Neem seed kernel Water	-30(32.61)	21**	15	0
Decon 90	-18.5(12.71)	96	0	0
Control		100	0	0

** $P < 0.01$ * $P < 0.05$

All extracts tested at 0.1g/ml

Encourages use of surfactant

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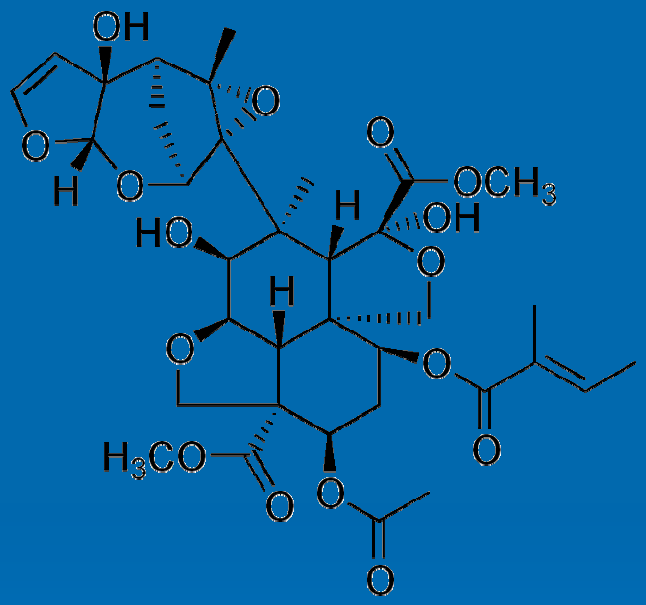
Azadirachta indica -
Proven efficacy but not used widely



- Plant location limits availability.
- Active compounds - terpenoids
  - Azadirachtin, Nimbin & Salanin
  - Deterrent & toxic
- Occurrence of active components inconsistent
  - Low levels or absent from leaf.
  - Neem seed kernel better source.
  - Azadirachtin highly labile and light sensitive.
  - Stability optimised by leaving in plant form.
- Azadirachtin extracts into water but not Nimbin or Salanin
  - implications for farmer use
  - Extraction with surfactant

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Safety & Toxicity of pesticidal plants

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- *Strychnos spinosa*
  - High mortality in mice at >25%
- *Solanum panduriforme*
  - known toxicity (Poison apple)
  - data being collated
- *Lippia javanica*
  - less toxic than *S. spinosa*
  - Used as herbal tea
- Need to determine toxicity
  - at concentrations < 25% w/v
  - topical application

– MSc student projects – at University of Zimbabwe, Harare.

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Sustainable production & propagation

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Securidaca longepedunculata

Effective but not abundant

Promoting use exacerbates problems of over-harvesting

Poor germination (<50% after 1 month).

Seedling growth slow.

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Sustainable production & propagation

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S. longepedunculata seeds sterlised and cultured on MS media (Murashige & Skoog, 1962)

Treatment time (mins)	Germination (%)
30	90
45	73
60	67

MSc project – Zambian at University of Bangor, Wales & RBG, Kew, UK.

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Sustainable production & propagation

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Providing microprop plantlets to farmers requires appropriate transfer technology

Potential exists for small enterprises

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Training and Capacity Building

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- Training target exceeded.
- 2 University of Greenwich, UK registered PhDs
- 12 MSc and 8 BSc students
- University of Zimbabwe, University of Mzuzu, University of Zambia and ICRAF MSc students, dissertations and other components of their degrees
  - Biological assays,
  - Toxicological studies
  - Plant micropropagation
- >8 Field and lab technicians
  - Field trials
  - Farmer surveys
  - Data evaluation
  - Insects & mites bioassays

BSc students at UNZA evaluating insect infestation from field samples.

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Publicity

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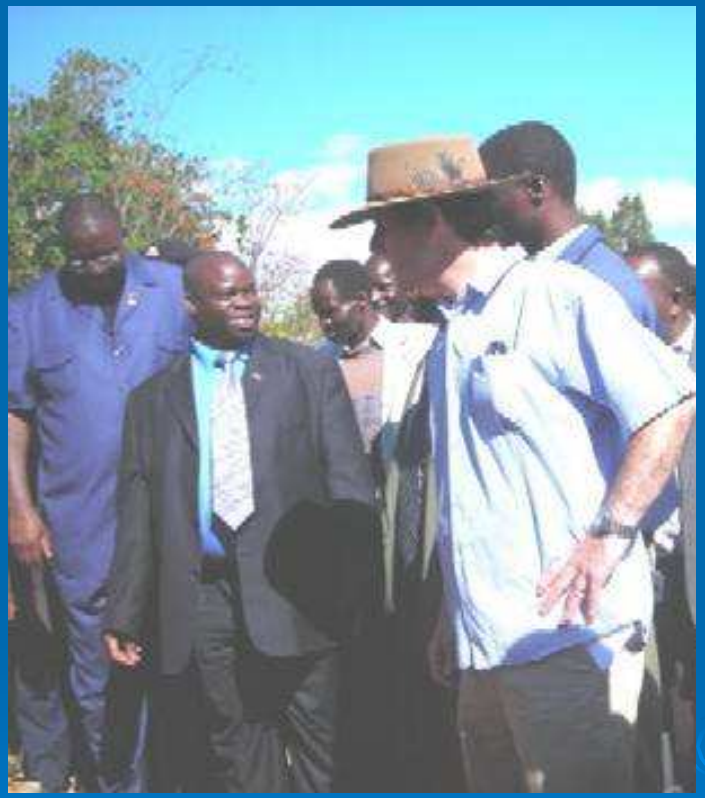
Interview for Malawi National Radio on SAPP project

Agricultural show, Rhumphi, Malawi



SAPP project leader, and Honourable Deputy Agriculture Minister, Mr Binton Kuntsaira, Malawi

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Thanks

- Farmers
- All the technical staff
- University of Zambia
- EU & SADC Funding & support

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