

# Natural Pesticides

## Intended Learning Outcomes – Participants will be able to:

1. Understand the advantages and limitations of natural insecticides for pest control
2. Know how to prepare natural pesticides using best practice guidelines
3. Decide which natural pesticides are appropriate for different kinds of pests
4. Experiment with different natural insecticides

## Pre-Requisites - Participants should have already studied the following modules:

1. Integrated Pest Management
2. Insect Identification and Monitoring

## Timing of this Lesson:

- This module is best done when there are active insect pests in the field.
- Depending on the insecticides being tested, this class can take up to 4 days:
  - Day 1 - prepare the insecticides
  - Day 2 - apply the insecticides
  - Day 3 or 4 - evaluate their effectiveness.

## References:



Anjarwalla P, Belmain S, Sola P, Jamnadass R, Stevenson PC. 2016. [Handbook on Pesticidal Plants](#). World Agroforestry Centre (ICRAF), Nairobi, Kenya.

OISAT. [Neem](#). Online Information Service for Pest Management in the Tropics.

NRI. 2017. [Pesticidal Plant Leaflet: \*Tephrosia vogelii\*](#). Natural Resources Institute, University of Greenwich.

Infonet-Biovision. [Natural Pest Control](#).

## Materials Needed:

1. 2 Posters: “Insect Life Cycles” and “Common beneficial insects”
2. Natural Insecticide Formulations Table (Appendix B in this Guide)
3. Pens and paper for participants
4. Garden or field crop near the training site
5. Small, clear plastic bags for collecting insect specimens
6. Several buckets (10 litres)
7. Hand lenses if available
8. Gloves and masks, gumboots, safety glasses for pesticide safety demonstration
9. Backpack sprayer or watering can
10. Liquid soap, 50 ml of cooking oil
11. Clean water

## Preparation:

1. Discuss availability of local insecticidal plants with key resource people including old persons in the community. Identify 2-3 best-bet species for the area.

2. For the sake of time, select one crop and the associated insect pests. Focus the experiment on one crop and one key insect pest.
3. Identify a field or garden with insect pests. Get the permission of the field owner to have participants enter the field and take plant/insect samples.
4. Review all discussion questions and be prepared to guide the discussion appropriately.
5. Familiarize yourself with the 10-Seed Method for participatory decision making (Appendix A).

### **Learning Activities (Total time required = 8 hours over 3-4 days)**

#### **I. Introduction: The use of natural insecticides in pest management (1 hour)**

##### **A. The first step in selecting and using natural insecticides is to evaluate what we already know. Ask the Participants the following questions:**

1. What are the major insect pests that affect crops in this area?
2. What natural insecticides do people already use to control these pests?
3. Do these natural insecticides usually work? Why or why not?
4. List each one on the flip chart; use plant parts if available or have someone draw them if working with illiterate farmers.
  - a) The name of the plant or natural product (use the local name to minimize confusion)
  - b) Which crops or animals are they used on?
  - c) Which pests are they used against?
  - d) How are they prepared (get specific quantities & methods)?
5. Ask participants to rate the effectiveness of each natural insecticides listed.  
Participants can rank the effectiveness from 1-5 with 1 being not very effective and 5 being very effective. If they are not literate use the 10-seed method (See Appendix A).
6. Select the top 2 or 3 locally known insecticides based on the participants' responses.  
***These will be tested in the field in the following activities, so be sure that they are a good match for the insect pests in the field you chose for the practical demonstration.***

- B. Explain that the goal of this lesson is to explore natural pesticides as a way to control pests, while minimizing negative impacts on humans and the environment. You will give them some guidelines, but they will also test natural insecticides in their own fields.**

**II. Review insect control options from the IPM lesson (30 minutes)**

**A. Use the IPM Pyramid poster to describe different control options:**

- a) **Cultural methods** (Practices that promote healthy plants: healthy soil, insect resistant varieties, crop rotation, timely sowing, plants to attract predators.)
- b) **Physical/Mechanical methods** (e.g. netting, traps, live barrier plants, etc.)
- c) **Biological methods** (e.g. beneficial/predatory insects)
- d) **Natural insecticides**, and finally **synthetic insecticides**

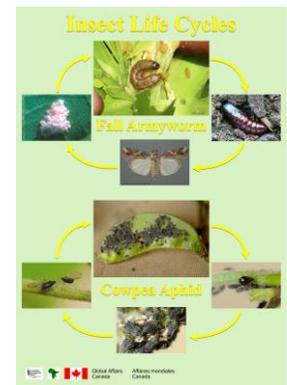
**B. Discussion Questions:**

1. What are the advantages of using natural insecticides instead of synthetic (chemical) insecticides? *Allow them to give their answers, but be sure they discuss that they cost less, they are not as toxic or dangerous, and they are not as harmful to beneficial insects.*
2. What are the limitations of natural pesticides? *Allow them to give their answers, but be sure they discuss the added labor demand, seasonal availability of materials, they do not always work.*
3. What are the dangers of using synthetic (chemical) pesticides? *Allow them to give their answers, but be sure they discuss the human health impacts and effects on beneficial insects*

**III. Present general guidelines for preparing and using natural insecticides (1 hour)**

**A. General Guidelines**

1. **Natural insecticides are most effective against the young stages of insect pests.** Insects with soft bodies are easier to kill than insects with hard bodies. *(Illustrate this using the “Insect Life Cycles” poster.*
2. **Crush or grind plant materials as finely as possible.** This allows the active ingredient to more effectively leach into the water.
3. **Add soap** (2-3 teaspoons liquid or 2-3 pinches powdered soap for ten litres of insecticide solution). Soap helps extract the active ingredients from the plant tissue, and helps the insecticide stick to the insect and the plant.
4. **Mix 1-10% plant material in water:**



- a) For fresh plant material use 1-5 kg per 10 liters of water.
  - b) For dried plant materials 100-1000 g per 10 liters of water.
5. **Dried plant material can be stored for times when fresh materials are not available.**  
When drying natural pesticides be sure to:
- a) Dry in shade since sunlight degrades many active chemicals
  - b) Store in a cool, dry place to maintain their potency.
6. **Spray in late afternoon-evening**
- a) Sunlight degrades many active chemicals, so avoid spraying during the hottest time of the day.
  - b) Spraying in the evening helps minimize the impact of sprays on beneficial insects.
  - c) Sprays containing oil can burn the leaves of the plant if they are used when the sun is very strong.
  - d) Avoid spraying just before a rain
7. **The potency of natural insecticides can vary with:**
- a) **Altitude** (e.g. Neem & Tephrosia have less insecticide when grown at higher altitudes)
  - b) **Genetics** (e.g. Tephrosia volgii has chemotypes that look identical, but some contain rotenoids and others contain none)
  - c) **Season** (some species may have higher pesticide content in the dry season while others have higher pesticide content in the rainy season)
  - d) ***For this reason it is IMPERATIVE that we test natural pesticides in each environment and each season to be sure they are working***
8. **Don't expect immediate results.** Many natural insecticides are insect repellants. This means that instead of killing the insect they drive the insect away from the plant. Evaluate the effectiveness of the spray 24-48 hours after spraying.
9. **Many natural insecticides need to be re-applied every week or two weeks.** Re-apply after checking the crop to see if another spray is needed.

## **B. Concluding Discussion Questions**

- 1. Refer the participants to the list of common local insecticides which they identified in the Introduction.
- 2. Ask participants to share how the common local practices compare to the guidelines just discussed?
- 3. Based on what they just heard, how might the common local practices be improved?

## **IV. Learning Activity: Preparing Natural Insecticides: Day One (1-2 hours)**

### **A. Measure plant materials**

- 1. Using the plants/natural insecticides identified in the previous activity, ask a participant to show the group how much plant material they would normally use for a 10 liter backpack sprayer.

2. Use a weighing scale to measure this quantity, and see how it compares to the above guideline of 1-5 kg fresh plant material or 100-1000 g of dried material. Increase the quantity of plant material they are used to using if it is too little according to these guidelines.
3. Discuss local measuring units based on volume, since most farmers will not have a weighing scale, and decide on a strategy for how they will measure plant material using this volume measure.

#### **B. Prepare the mixture**

1. Use mortar & pestle or whatever method is locally available and crush as finely as feasible.
2. Add 10 liters of water
3. Add 10 ml liquid soap (2 teaspoons)
4. Leave the mixture to sit until the following day. This will ensure that the chemicals in the plant are mixed in with the water.

#### **V. Spraying Natural Insecticides - Practical Experiment in the Field: Day 2 (1 hour)**

1. Count & record the current population of insects in the experimental site
2. Spray all treatments
  - a) Use a positive control (a synthetic pesticide) if available, and a negative control (no spray) to help evaluate the performance of the natural pesticide
  - b) Use different dosages (see recommendations listed in Appendix B)
  - c) Clean sprayer thoroughly with soap and water between each treatment
3. Cover with netting if evaluating flying insects

#### **VI. Evaluation of the Pesticides: Day 3 or 4 (1-2 hours)**

##### **A. Return to the experimental site**

1. Count the remaining insects on each treatment & determine how many are dead and how many are still alive.
2. Ask the participants which (if any) of the treatments they would recommend. What treatments would they like to try next time?
3. Discuss the importance of using different application rates, and the importance of repeating the trials until you are confident that you have a method that is effective.

#### **VII. Concluding Discussion (30 minutes)**

1. Ask participants to summarize the key lessons they have learnt.

2. Remind them that inconsistent performance of natural pesticides is normal. By testing, they can minimize this inconsistency and increase the effectiveness of their natural pesticides.
3. Ask if they have any unanswered issues.
4. Which of the natural insecticides will each farmer use in the future?
5. What natural insecticides would they recommend to their neighbors?

## **Appendix A: Ten-Seeds Method**

This method is used to help non-literate groups set priorities in a participatory manner. It can be used to select different crop varieties, different activities for the group to undertake, or even group leadership.

1. List the different options for which people will be voting. This may be done using pictures on pieces of paper. Discuss thoroughly what each option is to be sure that people know what they are voting for.
2. Place the papers on a table, or on the floor where all can see them.
3. Give every participant 10 seeds (or stones, or any other small objects). If you want to separate the answers of different groups (e.g. men and women) give a different kind of seed to each group.
4. Explain that each individual will use their seeds to indicate which option they prefer. They may put all their seeds on one paper, to indicate that they highly prefer this option, or they may distribute their seeds between several options which they like.
5. Allow everyone to place their seeds on the paper indicating the options they prefer.
6. Count the seeds on each paper to determine the group priority.
7. Ask Participants to discuss why they voted for the different options.
8. If, during the discussion, people's opinions are changed by the arguments of other group members, a second vote may be taken to finalize the decision.

## Appendix B: Natural Insecticide Formulations Table

Material	Target pests	Mode of action	Preparation and Application	Comments
<b>Neem</b>	Mostly effective on soft-bodied insects, larvae, and grasshoppers	Neem repels insects, disrupts their feeding and growth. It does not kill on contact.	<b>Seeds:</b> grind 500g dried seeds, soak in 10 liters water with 2 teaspoons soap for 24 hrs. <b>Leaves:</b> Grind 2-5 kg fresh leaves or 200-500g dried leaves, soak in 10 l water with 2 teaspoons soap for 24 hrs.	
<b>Tobacco</b>	Most insects	Kills on contact with pest	Soak 100-200g dried powder (10-20 rounded tablespoons) in 10 liters water with 2 teaspoons soap for 24 hours.	<b>Tobacco is a strong poison.</b> Use safety precautions as with synthetic insecticides. Do not apply on solanaceous crops. Toxic to bees and other beneficial insects.
<b>Tephrosia</b>	Soft-bodied insects including aphids and spider mites. Stored grain pests	The active ingredient is rotenone. Kills on contact or when eaten	<b>Spray:</b> Grind 2-5 kg fresh leaves or 200-500g dried leaves, soak in 10 liters water with 2 teaspoons soap for 24 hrs.	Plants having varying degrees of toxicity. Spot spray plants to avoid killing beneficial insects.
<b>Oil</b>	Aphids, young caterpillars, whitefly, young scale insects and mealybugs	Suffocates soft-bodied insects.	Mix 500 ml cooking oil with 50 ml soap in 10 liters water.	Do not use in the middle of the day or use more oil than called for or plant injury may occur. 200-
<b>Ash</b>	Soft-bodied insects, specially termites, weevils, stalk borers	Ashes dehydrate soft-bodied insects and deter some pests from attacking plants when spread as a barrier.	Dust plants when moist (e.g. when dew covered) or apply in funnel of growing maize. Spread on soil around plants.	Don't allow ashes to touch seedling stems as they are caustic. Reapply after a rain.
<b>Bt (<i>Bacillus thuringiensis</i>)</b>	Caterpillars (most effective when young)	Bt must be eaten to work. Caterpillars stop feeding and starve to death.	Commercial preparations of Bt can be bought under names such as Dipel, Javelin, Thuricide, etc.	Bt is a live bacterium, and must be stored in a cool place.
<b>Clay, lime or other powdery materials</b>	Ants, aphids, beetles, caterpillars, mites, etc.	The material can suffocate insects or eggs. Also can prevent sucking insects.		Do not use in a sprayer as it will clog the spray nozzle. Reapply after a rain.