INTEGRATED PEST MANAGEMENT

BY DR NEHEMIAH MIHINDO

EFFECTIVE IPM ASSOCIATION

Introduction

- Food security and increased income are the primary goals of most poor farmers throughout sub-Saharan Africa where the majority of agriculture is carried out on smallholdings, often of less than ONE hectare. Farm size limits what farmers can produce, and this can be a great burden when most families' livelihoods depend on the amount of food they can produce.
- It has been estimated that for every 10% increase in farm yields, poverty was reduced by 7% in Africa (Irz *et al.*, 2001). According to the International Fund for Agricultural Development (IFAD) an increase of just 1% in agricultural per-capita Gross Domestic Product (GDP) would reduce the poverty gap five times more than a similar increase in GDP in any other sector, and would particularly target the poorest people. So helping smallholders to produce more food can alleviate poverty.

Introduction cont

- Among the many factors that affect food production in Africa are pests and diseases that can lead to total crop failure. Accessibility of synthetic pesticides for pest and disease control is limited for many farmers due to their cost and restricted distribution networks. Products are frequently adulterated by unscrupulous traders, and inappropriate application can exacerbate pests and lead to pesticide resistance. Pesticidal plants are widely available at minimal or no cost to farmers, and have been used for centuries, so are culturally relevant.

- *Pests are organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or damage homes or other structures. Pests also include organisms that impact human or animal health. Pests may transmit disease or may be just a nuisance. A pest can be a plant (weed), vertebrate (bird, rodent, or other mammal), invertebrate (insect, tick, mite, or snail), nematode, pathogen (bacteria, virus, or fungus) that causes disease, or other unwanted organism that may harm water quality, animal life, or other parts of the ecosystem*

What is a pesticide

- The word pesticide derives from the Latin *pestis* (plague) and *caedere* (kill)

- Food and agriculture Organization (FAO) any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.

Classification of pesticides

- Pesticides can be classified based upon their mode of action, which indicates the exact biological mechanism which the pesticide disrupts

Pesicide	Target pest group
Algicides or algaecides	Algae
Avicides	Birds
Bactericides	Bacteria
Fungicides	Fungi and oomycetes
Herbicides	Weeds
Insecticides	Insects
Lampricides	Lampreys[4]
Miticides or acaricides	Mites
Molluscicides	Snails
Nematicides	Nematodes
Rodenticides	Rodents
Slimicides	Algae, Bacteria, Fungi, and Slime molds

Problems associated with pesticides

- Pesticides can cause short-term adverse health effects, called acute effects, as well as chronic adverse effects that can occur months or years after exposure. Examples of acute health effects include stinging eyes, rashes, blisters, blindness, nausea, dizziness, diarrhea and death. Examples of known chronic effects are cancers, birth defects, reproductive harm, immunotoxicity, neurological and developmental toxicity, and disruption of the endocrine system.

↑ Skin problems caused by pesticide exposure.


GREENBERG VCReporter 2010 steve@greenberg-art.com
METHYL
IODIDE
USE

- Pesticides are expensive
- Most pesticides are non selective

Integrated Pest Management

- IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques aimed at manipulating the pest population in order to keep them below economic injury levels

IPM benefits

- Less Harm to Natural Biodiversity: By targeting specific species rather than outright damaging a certain environment, IPM practices ensure that biodiversity is protected. A healthy ecosystem houses a large number of different species all carefully balanced with other animal populations. Put the safety of nature first by protecting biodiversity with careful IPM pest control techniques

- Balanced Environment, Happy Ecosystem: At first glance, it might be tempting to completely wipe out the entire pest population. However, in most cases, it is vital to the health of the ecosystem to manage pest populations rather than exterminate them. This is because even pests are a delicate part of a healthy environment. Additionally, the overuse of pesticides can also harm other animal species as well.

- Lowered Rates of Pesticide Resistance: Using pesticides too frequently can cause a resistance to build up over time, lowering the overall effectiveness of chemical pest control. In order for pesticide or chemical use to take strong action against pest infestations, pesticide treatments should only be used in extreme cases and when balanced with other forms of IPM methods. When using pesticides, the weak die out and the strong survive. Over time, the stronger pests develop resistance to pesticides, resulting in long-lasting pest issues. By using a range of different IPM techniques, true pest control specialists can effectively solve pest problems.

- More Cost Effective: IPM is the more cost-effective choice in the long run, as it prioritizes healthy ecosystems and values the environment. If nature is healthy, that will pay off for generations and generations to come. By using IPM techniques such as chemical and mechanical controls, nature is able to better self-regulate —which takes less time and energy on your part

- Effective, Healthy Results: Aside from the financial benefits, promoting safety is never a disadvantage. When it comes to IPM forms of pest control, health is never sacrificed for results. Pest control specialists trained in IPM techniques can accurately determine the right combination of techniques to combat each unique form of pest population —all without leaving lasting damage to the earth.

ROLE OF IPM IN AGROECOLOGY

- **Applies sustainable pest control.** IPM builds on ecosystem services such as pest predation while protecting others, such as pollination. It also contributes to increased farm productivity and food availability by reducing pre- and post-harvest crop losses.

- **Reduces pesticide residues**. IPM contributes to food and water safety, as reducing the amount of pesticides used in turn reduces residues in food, feed and fiber, and environment

- **Enhances ecosystem services**. IPM seeks to maintain the national crop ecosystem balance. It conserves the underlying natural resource base (i.e. soil, water and biodiversity) and enhances ecosystem services (i.e. pollination, healthy soils, diversity of species).

- **Increases income levels**. IPM reduces production costs through reduced levels of pesticide use. Higher quality crops (with less residues) can command better prices in markets and contribute to increased farmer profitability.

- **Strengthens farmer knowledge**. IPM promotes farmer stewardship, increases farmer knowledge of ecosystem functioning adapted to their local context

ESSENTIALS OF AN IPM PROGRAM

- **Monitoring.** This includes regular site inspections and trapping to determine the types and infestation levels of pests at each site.
- **Record-Keeping.** A record-keeping system is essential to establish trends and patterns in pest outbreaks. Information recorded at every inspection or treatment should include pest identification, population size, distribution, recommendations for future prevention, and complete information on the treatment action.
- **Action Levels.** Pests are virtually never eradicated. An action level is the population size which requires remedial action for human health, economic, or aesthetic reasons.
- **Prevention.** Preventive measures must be incorporated into the existing structures and designs for new structures. Prevention is and should be the primary means of pest control in an IPM program..
- **Evaluation.** A regular evaluation program is essential to determine the success of the pest management strategies.

IPM METHODS
1. Cultural method

Revolves around the use of different agronomic practices in the field which are not meant for pest management but end up helping in reducing their population.

They include:

- Timely planting
- Soil cultivation
- Weeding
- Watering

Cultural methods cont

- Fertility management
- Crop rotation
- Clean planting meterials

2. Behavioral method

- Involves the deliberate change of behavior of pests by introducing favorable or unfavorable conditions

1. Use of attractants e.g. if you planting sunflower in a maize field all weaver birds will be attracted to the sunflower and leave your maize
2. Use of repellants e.g. onions, garlic, dania, Mexican marigold if intercropped with vegetables will repel a number of soft bodied insects.

4. Biological methods

- Revolves around the use of living organisms to manage pests (natural enemies
- They include :

1. Preditors: These are organisms that prey and feed on other organisms. They often feed on various stages of the host (pest): eggs, larvae, pupae and adult.
2. Parasitoids: Organisms that during the larval stages feed on pests (external parasitoids) or *in* the pest (internal parasitoids). They complete their development on a single host, killing it. In their adult stages they are mostly free-living and feed on pollen and nectar or other sugary substances such as honeydew.

- The most common parasitoids are parasitic wasps and flies

Parasitoids cont

- some parasitoids lay eggs in or on other species of insect (called hosts) and the larval stage kills the host as it feeds on it and develops

Pathogens:

- Organisms that can cause diseases of pests. They include fungi, bacteria, viruses and nematodes. They can be important in controlling pest populations in agricultural systems. However, naturally occurring pathogens often are too rare to serve as important control agents or occur when the damage has already been done.
- Some pathogens such as the bacterium *Bacillus thuringiensis* (Bt) and the fungus *Trichoderma viride* are commercially available in many countries, including Kenya
- Other fungi such as *Zoophthora, Verticillium* and *Entomophthora* can be readily found in the field at particular times of the year, infecting aphids, beetles, caterpillars, grasshoppers and whiteflies.

Cont

.

3. Pathogens: These are fatal or debilitating diseases to arthropod pests and include fungi nematodes, bacteria, viruses, and other microbes. Fungi, particularly *Deuteromycetes*, can infect pests externally under favourable conditions, but other pathogens must be ingested to be effective as control agents. Pathogens are very specific to their hosts

Examples of predators – lady bird

Hoverfly

Assassin bug

Chameleon

Praying mantis

Rove beetle

Predatory wasp

Predatory thrip

Predatory mite

PARASITOIDS
parasitic wasp

Braconid wasp

Tricnid fly

Conservation of natural enemies

- Reduced use of chemicals that are non selective and will kill both the pestd and their natural enemies
- Growing flowering plants which provide nectar and pollen to farmers' friends such as adult parasitoid wasps, hover-flies and ladybird beetles adults by having living fences (hedges) around the crop to provide shelter and refuge for farmers' friends should be encouraged. These are called refugia, and examples include beetle banks (grassy areas near crops) flowering plants and unsprayed field edges
- Mulching and having life fences to provide habitat for ground for natural enemies

BOTANICAL PESTICIDES

- Plants that are sources of botanical pesticides are easily available in the environment and most of them have multiple uses such as medicines, spices, ornamentals, food and or as feed Their availability makes them inexpensive and hence they are easily incorporated into agricultural production systems
- Commercialized pesticides from plants such as pyrethrum, neem and sabadilla are some of the least toxic especially to non-targets organisms such as pollinators and fish. This attribute makes botanical pesticides effective, reliable and acceptable in sustainable crop protection

- In addition, they do not leave residues on crop produce and the environment thus contributing to environmental conservation and ensuring safety to consumers

- The interaction between botanical pesticides and the pests is naturally biochemical therefore pests are unlikely to develop resistance

- The plant-based chemical compounds in extracts and essential oils are target specific which ensures safety on non-target organisms especially the beneficial organisms including pollinator bees and predators

- The plant-based chemical compounds in extracts and essential oils are target specific which ensures safety on non-target organisms especially the beneficial organisms including pollinator bees and predators

- Depending on the source plant and the concentrations used, the botanical pesticides have zero or little allelopathic effect on crops

- The increasing interest in natural plant products in medicine, agriculture and food industry has spurred research in the composition of compounds in various plant families

- The common bioactive compounds in botanical pesticides are majorly secondary metabolites such as steroids, alkaloids, tannins, terpenes, phenols, flavonoids and resins that possess antifungal, antibacterial, antioxidant or insecticidal properties

- The specific compounds found in given species of plants make them effective against a given category of pests

MECHANISMS OF ACTION OF BOTANICAL PESTICIDES

- The bioactive compounds in botanical pesticides have varied modes of action against different pests including insects, fungi, bacteria, nematodes and plant host cells infected by viral pathogens

- The modes of action include repellence, inhibition, denaturation of proteins and other effects depending on type of botanical compound and pest. For instance, pesticides from pyrethrum target the nerve cells of insects leading to paralysis and later death while neem-based pesticides have anti-feedant and repellence properties, induce moulting abnormalities, hinder oviposition and disrupt the endocrine system

ROTENONE

- **Structure.** $C_{23}H_{228}O_6$
- **Source.** Rotenone is insecticidal compound that occurs in the roots and leaves of Tephrosia Vogeli species, Derris species and several other related tropical legumes.
- Rotenone is extracted from cube roots in acetone or ether. Extraction produces a 2-40% rotenone resin which contains several related but less insecticidal compounds known as rotenoids. The resin is used to make liquid concentrates or to impregnate inert dusts or other carriers. Most rotenone products are made from the complex resin rather than from purified rotenone itself. Alternatively, cube roots may be dried, powdered and mixed directly with an inert carrier to form an insecticidal dust.
- **Mode of action.** Rotenone is a powerful inhibitor of cellular respiration, the process that converts nutrient compounds into energy at the cellular level. In insects rotenone exerts its toxic effects primarily on nerve and muscle cells, causing rapid cessation of feeding. Death occurs several hours to a few days after exposure. Rotenone is extremely toxic to fish, and is often used as a fish poison (piscicide) in water management programs. It is effectively synergized by PBO or MGK 264.

Tephrosia Vogelii

NICOTENE

- **Source.** Nicotine is a simple alkaloid derived from tobacco, *Nictiana tabacum*, and other Nicotiana species. Nicotine conStitutes 2-8% of dried tobacco leaves. Insecticidal formulations generally contain nicotine in the form of 40% nicotine sulfate and are currently imported in small quantities from India.

- **Mode of action.** In both insects and mammals, nicotine is an extremely fast-acting nerve toxin. It competes with acetylcholine, the major neurotransmitter, by bonding to acetylcholine receptors at nerve synapses and causing uncontrolled nerve firing. This disruption of normal nerve impulse activity results in rapid failure of those body systems that depend on nervous input for proper functioning. In insects, the action of nicotine is fairly selective, and only certain types of insects are affected.

NEEM

- **Source.** Neem products are derived from the neem tree, *Azadirachta indica*, that grows in arid tropical and subtropical regions on several continents. The principle active compound in neem is azadirachtin, a bitter, complex chemical that is both a feeding deterrent and a growth regulator. Meliantriol, salannin, and many other minor components of neem ar also active in various ways. Neem products include teas and dusts made from leaves and bark, extracts from whole fruits, seeds, or seed kernels, and an oil expressed from the seed kernel.

- The product known as "neem oil" is more like a vegetable or horticultural oil and acts to suffocate insects.

- **Mode of action.** Neem is a complex mixture of biologically active materials, and it is difficult to pinpoint the exact modes of action of various extracts or preparations. In insects, neem is most active as a feeding deterrent, but in various forms it also serves as a repellent, growth regulator, oviposition (egg deposition) suppressant, sterilant, or toxin.

LIME SULPHUR BREW

- Lime-Sulphur brew
- Use: The sulphur acts against pests and working together with microbiology forms sulphur oxide
- which helps break down organic matter.
- Ingredients:
- 100L of water

- Boil the water
- - Mix the lime and the sulphur (break the lumps of sulphur) in dry conditions and add to the water.
- - Once the sulphur has become soluble mix for 20-30min on the surface of the mix to form a
- vortex then take off the fire. The mixture should be dark brick red when taken off the fire.
- - Let cool down, take of the upper layer that has formed and it is ready.

- Keep some cool water near the brews, when it gets too hot the water will rise and with a little
- cool water it will reduce in size again.
- This brew can last up to 12 months. To preserve put in a coloured (no light exposition) glass
- bottle and add a little oil at the top to prevent oxygen from reaching.
- The paste left at the bottom can be used to cover trees scars!! Very effective!!
- Application:
- - Dilute 3-5L in 100L of water (3-5%) and use as folia-spray

SOIL TESTING