PESTICIDE HAZARDS IN BEE COLONIES AND HIVE PRODUCTS

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Pesticides

- A chemical, physical or biological agent that destroys or controls pest organisms
Insects, rodents, weeds, fungi are competitors in humanity feeding.
Classification of Pesticides

Pesticides (by Effects)

Target Organism - Insecticides, herbicides, fungicides, miticides, rodenticides, etc

Chemical structure

**FUNGICIDES**
- Thiocarbamates
- Dithiocarbamates
- Cupric salts
- Tiabendazoles
- Triazoles
- Dicarboximides
- Dinitrophenoles
- Organotin compounds

**INSECTICIDES**
- Pyrethroids
- Organophosphorus
- Carbamates
- Organochlorine

**FUMIGANTS**
- Aluminium and zinc phosphide
- Methyl bromide
- Ethylene dibromide

**HERBICIDES**
- Bipyridyls
- Chlorophenoxy
- Glyphosate
- Acetanilides
- Triazines

Polar vs Non-polar

Volatile vs Non-volatile
BENEFITS

- Crop protection
- Food preservation
- Material preservation
- Disease control
- Improved the living standards of farmers
- Benefits whole society

RISKS

- Toxic to humans
- Impact on environment and ecosystems
- Toxic to pollinators
The Good Evil

- Public health: disease prevention (malaria, typhus, yellow fever) and increased agricultural production

**DDT Story? “wonder chemical”**

- Saves lives through prevention of malaria, DDT kills mosquito’s

- Malaria kills over 800,000 people every year and about 100 children every day.

- DDT and its byproducts cause
  - breast & other cancers
  - male infertility
  - miscarriages & low birth weight
  - developmental delay
  - nervous system & liver damage

- Banned or restricted in most countries due to its bioaccumulation in the food chain
DDT – A Chlorinated Hydrocarbon

Forbidden or significantly limited: on northern hemisphere of Earth

Developing countries: large number of infection (malaria, yellow fever) pest: threat of food production (e.g. termites)

options in Africa

premature death (famine or infection)

longer life (chronic effect of chlorinated hydrocarbons)

http://www.eoearth.org/article/Chemical_use_in_Africa:_opportunities_and_risks
Pesticide Residues
How Do these Residues Move?

http://www.ecifm.rdg.ac.uk/pesticides.htm
Environmental Aspects of Pesticides

Life of pesticides:

- Effect reduction - 95 % environmental conditions

Fast degradable agent: degradation 1 – 12 weeks
Moderately fast degradable agent: degradation 1 – 18 months
Slowly degradable agent: degradation more than 2 years

Disadvantage of slowly degradable agents:

a. Accumulation in food chain
b. Development of resistance

New type pesticides: fast degradation advantageous
Degradation types: biological, photochemical, water hydrolyses
Obsolete Pesticide Stockpiles: Unwanted Legacy of the African Landscape

- Commercial interest of pesticide industry
- Inaccurate prediction of the occurrence of pests
- Purchase in excess or requirements
- Unsuitable products or packaging
- Weak law enforcement and institutional framework.
- Banning of products
- Donations
- Poor pesticides management

Inventory of obsolete and unwanted pesticide stocks

Quantities in metric tonnes
- > 1,000
- 500-1,000
- 50-500
- 5-50
- Under inventory
- Not quantified

Map of Africa showing quantities of obsolete pesticides.
Protect bees as a matter of life or death

Bees are important for crop pollination, hence sustaining agriculture, yet chemicals banned elsewhere for killing bees are still on sale in Africa.

Bees provide 1/3 of the food we eat...
Major Routes of Exposure for Bees to Pesticides

SPRAY APPLICATION
- Deposition on flowering plants
- Deposition on flying bees
- Spray drift
- Dust
- Volatilisation

SYSTEMIC PESTICIDES
- Plant uptake
- Migration through soil
- Non-Apis nest
- Foraging bees returning to hive
- Deposition on flowering weeds
- Pollen and nectar

Guttation fluid or honeydew on leaves

Pollen and nectar
Pesticides Impact on HoneyBees

- Acute kills
- Chronic Effects:
  - Impaired immune function
  - Impaired reproduction
  - Lowered queen survival
- Habitat Effects:
  - Monocultures in agricultural areas
  - Herbicide use reduces roadside and fieldside forage
  - Invasive weed management efforts using herbicides reduce forage availability
- Other Effects:
  - Impaired navigation
Hive Products: Samples from Colonies

- Flower pollen
- Bee bread
- Honey
- Propolis
- Beeswax
- Royal jelly
Quality Control of Honey and Hive Products

Goal: To comply with International Honey Standards specified in the Codex Alimentarius Standard for Honey.

- Contaminants
- Moisture content
- Mineral content (ash)
- Sugar content
- Proline content
- Acidity
- Hydroxymethylfurfural content
- Diastase activity
- Invertase activity

Go Organic!!!!!!
Sample Storage and Shipping
Pesticide Residue Analysis: LC-MSMS

Liquid Chromatography/Mass Spectrometry
Quality Control Analysis

Gas Chromatography/Mass Spectrometry (GC-MS)

High Performance Liquid Chromatography (HPLC)