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SEMIS - UJON

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1. Biosafety And Environmental Issues In Pest And Disease Management

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# BIOSAFETY AND ENVIRONMENTAL ISSUES IN PEST AND DISEASE MANAGEMENT



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# Definitions



## Biosafety

The avoidance of risk to human health and safety, and to the conservation of the environment, as a result of the use for research and commerce of infectious or genetically modified organisms

The need to protect human and animal health and environment from the possible adverse effects of the products of modern biotechnology

## Environment

The whole complex of climatic, edaphic and biotic factors that act upon an organism or an ecological community and ultimately determines its form and survival

## Ecosystem

Plants, animals and microorganisms that live in a defined zone and the physical factors present e.g. soil, water and air

## Pesticide

A Pesticide is a chemical used to prevent, destroy or repel pests



# Introduction



- Crop pests (plant pathogens, vertebrate and invertebrate crop pests, weeds) 30% of crop loss
- Qualitative and quantitative yield losses
- Loss is at field level or at post harvest level
- Loss a major challenge to attainment of food security and even food safety
- An adequate, reliable food supply cannot be guaranteed without the use of crop protection products.
- world population has doubled in the last 40 years, the area of land devoted to food production has remained virtually constant; crop protection products have enabled farmers to produce higher yields of their crops on more or less the same land



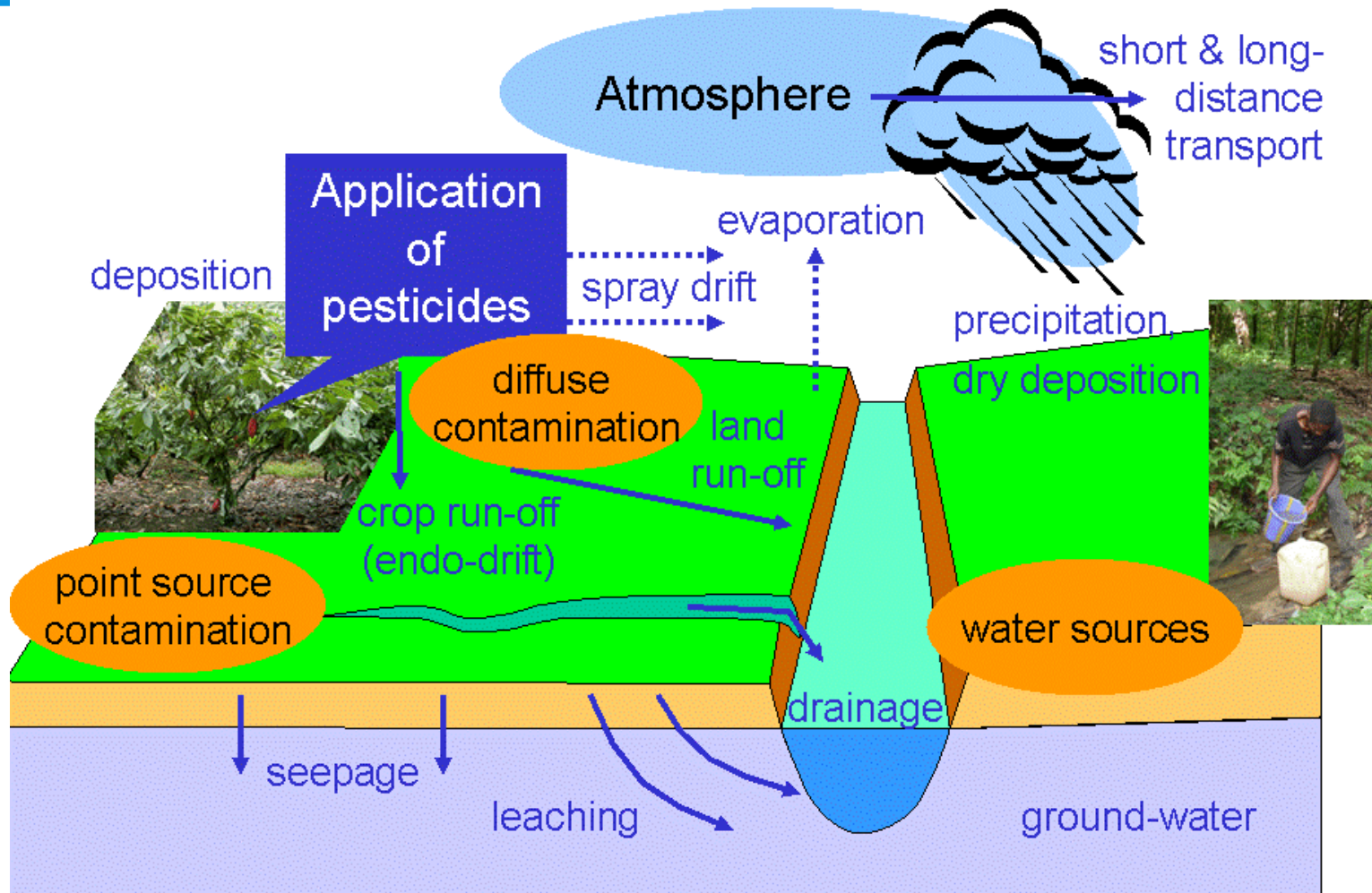
# Introduction continued



- Due to the losses growers apply various measures. Pesticides are preferred more
- There has been overreliance in the use of chemical pesticides and this is due to
  - i. Pesticides have fast knockdown effect
  - ii. Pressure from agro-chemical firms (advertisements). Ease of availability/access
  - iii. Lack of alternatives such as access to resistant varieties, biological control agents
  - iv. Lack of technical knowhow on the most appropriate management strategies (such as IPM strategies)



# Pesticide pathways





# Safety issues

- Pesticides are poisons- potential to cause harm
- All pesticides are toxic. Toxicity is measured in terms of Lethal Dose 50
- Toxicity depends on the chemical properties, routes of exposure and duration of exposure
- Use of pesticides presents a hazard to the user, consumer, non-target organisms and the environment

## **Categories of recipients due to pesticide pollution**

### **(a) User or agricultural workers**

- Exposure to the pesticide during mixing and application (acute and chronic effects)





# Safety issues



## (b) Consumer

- Exposed to chronic poisoning
- Chemical residues
- (maximum residue levels)
- Acceptable Daily Intake

## (c) Non-target organisms

- Affects beneficials especially non-selective pesticides e.g. Fumigants
- Pest resurgence and secondary pest outbreak



# Safety issues



## (d) Environment

- Pollution-pesticides degrade the environment
- Effect on environmental pollution depends on toxicity, formulation, persistence

### Various components of the environment are affected

- I. **Air**- due to spraying- pesticide formulations
- II. **Water**- Spillage, wash out from the atmosphere, surface run-off
- III. **Land**- disposal of empty pesticide containers and unwanted pesticides



# crop protection activities with biosafety issues

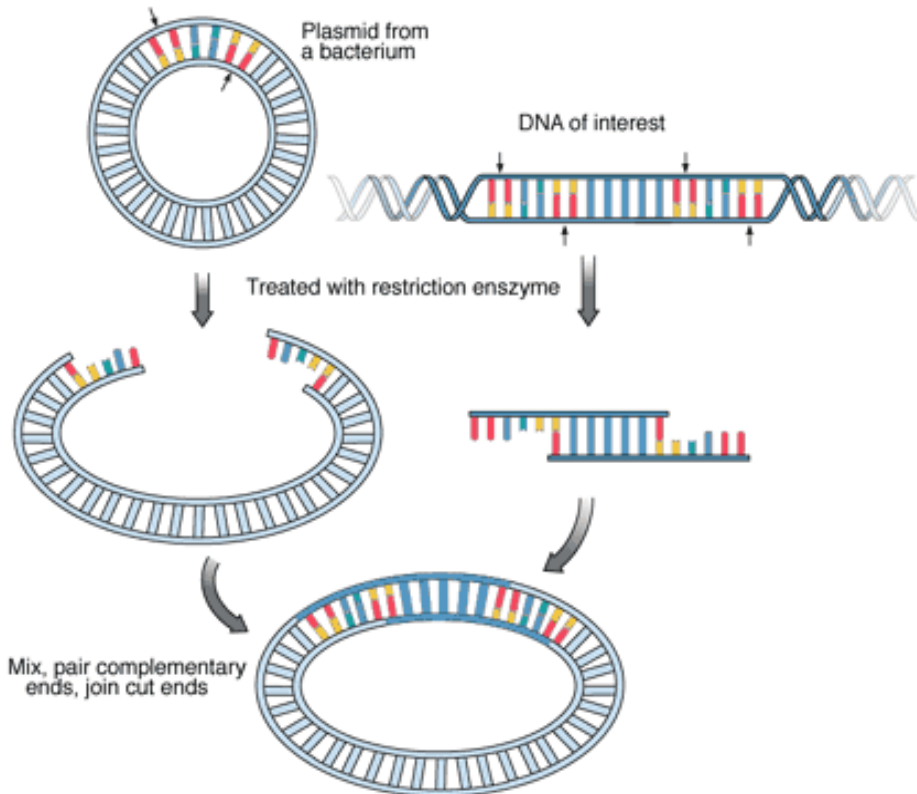


## Introduction

- GMO is an organism whose genetic characteristics have been altered using the techniques of genetic engineering. (transgenic)
- organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by crossing and/or natural recombination
- The technology is often called “modern biotechnology” or “gene technology” or “recombinant technology” or “genetic engineering”
  - allows selected individual genes to be transferred from one organism into another, also between nonrelated species
  - Foods produced from or using GM organisms are often referred to as GM foods.
- LMO is any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.



# Illustration of this process





## Biosafety continued



### Use of genetically modified organisms

- Is governed by Cartagena Protocol on Biosafety
- Is a supplement to the Convention on Biological Diversity
- Seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology
- Ensuring an adequate level of protection and safe transfer (transboundary movements), handling and use of GMOs
- Biosafety seeks to avoid adverse effects on the conservation and sustainable use of biological diversity, taking into account risks to human health
- Basic premises on CBD (Decision on the basis of scientific risk assessment and Precautionary Principle)



# Convention of Biodiversity (CBD)



- Recognizes the potential of modern biotechnology in causing harm to human well being (health)
- Takes cognizance that modern biotechnology could have serious effects on environment
- Article 8 (g) emphasized the need to regulate the risks associated with the use of LMOS.
- Article 19 (3) set the stage for a legally binding international instrument about biosafety.



# Biosafety issues associated with GMOs



## Risks for animal and human health:

- Toxicity & food/feed quality/safety- Plants may produce secondary metabolites that may be toxic to humans or livestock
- Allergies/triggering of allergies due to genetic modification - allergenic properties of food from a donor plant might be conserved on the host resulting to genetically modified food containing a new allergic protein
- (human safety) due to pathogen drug resistance from vectors used for transforming plant cells

## Risks for agriculture:

- Resistance/tolerance of target organisms (super pests)
- Alteration of nutritional value (attractiveness of the organism to pests)
- Loss of familiarity/changes in agricultural practice

## Risks for the environment:

- gene flow; invasiveness (of GMOs might become predominant)
- susceptibility of non-target organisms
- changes to biodiversity- resulting mainly to loss of biodiversity



- genetic pollution through pollen or seed dispersal & transfer of foreign gene to micro-organisms (DNA uptake) or generation of new live viruses by recombination
- Development of herbicide resistant plants may encourage the use of greater amounts of herbicides, with harmful effects on environment.

### ethical issues

- risk assessment/risk management –feeling that is not adequately being addressed
- public attitudes, perception-blurring of species, religious views
- socio- economics- patenting GMOs and users e.g. farmers will have to pay royalties to sow the crops.
- Additional of terminator genes in crops to render the seeds sterile forcing farmers to buy seeds every time since they cannot replant.
- GM traceability / commodity segregation –consumers want information explicitly as to whether the food stuff is GMO to address their preferences





# Mitigation of safety and environmental issues -pesticides



- Adoption of IPM approaches
- Good agricultural practices (GAP) (selection of pesticides based on toxicity category, PHI, safe re-entry intervals among other considerations)
- Safe use-handling (storage application)
- Ensuring sustainable and safe use of pesticides- avoid routine application but follow threshold levels
- Strengthening regulatory framework of crop protection products (national, regional, and international legislation that helps ensure safety for users, consumers and the environment)
- Education and training programs that inform how products can be used safely and efficiently



# Mitigation cont'd



- Regulation on the introduction of GMOs- regulatory framework  
Needed (In kenya National Biosafety Authority)
- Rigorous Scientific Assessment
- Adoption of precautionary principle
- Prevention of the spread of genetically engineered material outside lab/field--biocontainment



## Conclusions

- Pesticides though toxic have a role to play in crop protection
- Judicious use of pesticides is needed to reduce/eliminate harmful effects on the non-target organisms and the environment
- Knowledge on IPM approaches, availability of the various strategies, GAP information integral in the safe use and protection of non-target organisms and the environment
- Goals of responsible pesticide users follow good practices that achieve effective pest control and little risk to environment



## Conclusions cont'd

- Biosafety is integral to modern biotechnology
- The adoption of modern biotech products needs to be balanced with adequate biosafety safeguards
- Case by case scientific risk assessment and cost benefit analysis
- modern biotechnology has potential for improvement of human well being and the environment