Guide

Safe Use of Pesticides and Agricultural Inputs

"REDUCTION OF PESTICIDE RUNOFF INTO THE CARIBBEAN SEA"
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A fundamental objective of the Colombian Banana Growers Association (Asociación de Bananeros de Colombia – AUGURA) is to promote and implement projects that focus on enhancing sectoral productivity and competitiveness. Therefore, it has driven different programmes and research efforts in partnership with other entities to help growers improve their agricultural practices and to compete in the current markets.

Product quality presently includes the manner in which a given product has been produced; and such process must, among others, be aligned with national and international environmental regulations and environment-related market demands.

The partnership between the United Nations Environment Programme (UNEP) and the Asociación de Bananeros de Colombia, AUGURA resulted from the “Reduciendo el Escurrimiento de Plaguicidas al Mar Caribe” (REPCar) project (Reducing Pesticide Runoff to the Caribbean Sea). Funded by the Global Environment Facility (GEF), the project is coordinated by the UNEP’s Caribbean Regional Coordination Unit with the
participation of Colombia, Costa Rica and Nicaragua.

Demonstration projects and training efforts headed by AUGURA within the REPCar Project framework seek to build awareness among growers on how their activities influence natural resource conservation, including marine ecosystems. These ecosystems are fundamental for tourism and fisheries activities in the region, thus contributing to the economy of coastal zones and the well-being of their inhabitants. Likewise, the Project seeks to provide tools for growers to strengthen their productive systems, increasing the competitiveness of the banana and plantain sector.

In this sense, AUGURA, with the support of UNEP, is pleased to share the following educational materials:

- Compendium of Good Agricultural Practices for Banana in the Magdalena region
- Integrated Pest Management for Banana and Plantain Crops.
- Pesticide Handling Manual

We are sure these consultation materials will be helpful to growers, marketers, researchers and all stakeholders of this agro-industrial sector interested in implementing best practices to reduce the risk of pollution and foster safe food, as well as strengthen positions in international markets and sustainable development in the region.

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Introduction

Environmental effects related to the use of agrochemicals are subject to closer monitoring today by national and international environmental organizations. Colombia has participated more actively in commitments and conventions focused on the global environment enhancements required by international markets.

Decree 1843 of 1991, Article 172, provides that persons working with pesticides must receive training from their employers. Such training, including theory and practice, covers a minimum of sixty (60) hours per year, cumulative, and the contents must relate to the corresponding activity (Decree 1843, Art. 172).

The Crop Protection Industry Chamber of the National Industry Association (Cámara de la Industria para la Protección de Cultivos de la Asociación Nacional de Industriales – ANDI) signed Agreement No 00074 with SENA, which foresees training on the safe and efficient use of pesticides, aimed at professionals, workers and all persons handling pesticides.

The foregoing document summarizes the educational materials in Agreement No 00074 (MEMORIAS USO ADECUADO Y EFICAZ DE PRODUCTOS PARA LA PROTECCIÓN DE CULTIVOS), with visual contents and language easily understood by banana and plantain workers. This publication is a basic tool for the permanent training of producers and workers.
2. Objectives

This publication seeks to provide simple and clear training for banana and plantain farm workers on the safe use of pesticides and agricultural inputs.

3. –General Definitions

General 3.1. Agro-inputs

Components of the agricultural production systems used to improve crop production conditions; pesticides, fertilizers and soil conditioners.

3.2. Plant Nutrition

Process through which plants absorb nutrients from the soil to develop and grow.
3.3. Fertilizers

Products added to a crop to ensure adequate plant nutrition.

**Simple:** They contribute one single nutrient per product, either nitrogen (N), phosphorus (P), or potassium (K), in sources like urea, potassium chloride and phosphoric rock.

**Compounds:** Contribute several sources of nutrients in one single product, such as 15 N – 15 P – 15 K, 10 N – 30 P – 10 P.

**Foliar:** Soluble sources containing major and minor elements Zn, Cu, Fe, B.

3.4. Pests

Organisms that may affect human beings or their assets.

**Pest Species**

Species that may cause damage in a region or country.

**Classes of pests**

**Vertebrates:** Rodents, rats, squirrels and birds

*Figure 2. Mouse*
**Invertebrates:** Insects, Mites, Mollusks, Fungi, Bacteria, Viruses, Nematodes and Weeds

**Insects:**

Affect leaves, flowers, fruit, roots, branches or stems of plants by chewing, perforating, boring or sucking sap. They consume harvested products, may transmit viruses and protozoa, inject toxins, and transport and protect other pests.

Over one million insects have been classified, 600 of which are considered severe pests.
**Mites**

Suck sap; consume common grains in dry seasons and greenhouses. Thirty thousand classified species. Ticks are the most common mites.

Figures 12 & 13. Mites
Mollusks:

Slugs and snails; common on vegetables, some snail species are edible.

Fungi:

More than 100,000 species classified, 8,000 of which may cause damage or problems to their surroundings.
Bacteria

Over 180 species classified

Figure 18. Image - Bacteria

Figure 19. Internal moko disease symptom

Viruses

Three hundred species classified on plants

Figure 20. Image - virus

Figure 21. Cucumber mosaic virus

Figure 22. Infectious clorosis virus
Nematodes

More than 10,000 species classified; 500 of phyto-sanitary importance

Weeds

Any plant foreign to a crop which competes against it but which may be useful for soil conservation and attraction of deep nutrients, among others.
3.5. Disease

Alteration of an organism (plant, animal and human) caused by internal and external factors, expressed as negative factors.

**Figure 29.** Diseased condition, bananas with moko disease

**Figure 30.** Healthy condition

Diseases may be classified as physiological or pathological in nature (caused by pests).

**Physical or Chemical Agents**

- Extreme temperatures
- Excessive or insufficient humidity
- Nutrient deficiency or toxicity
- Salinity
- Pollution
Conditions for the presence of a phyto-sanitary problem:

3.6. Pesticides

Any chemical substance, biological agent or mixture used to fight, destroy, control, prevent, mitigate or repel the action of pest organisms that affect the health or well-being of humans, animals and useful plants.

These are classified according to the pest they control:

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Pest controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticides</td>
<td>Insects</td>
</tr>
<tr>
<td>Nematicides</td>
<td>Nematodes</td>
</tr>
<tr>
<td>Fungicides</td>
<td>Fungi</td>
</tr>
<tr>
<td>Bactericides</td>
<td>Bacteria</td>
</tr>
<tr>
<td>Herbicides</td>
<td>Weeds</td>
</tr>
</tbody>
</table>
**Other agro-inputs**

**Hormones:** Products to stimulate growth, flowering and fruit set of plants and crops

**Disinfectants:** Products used to clean tools and post-harvest areas

**Adjuvant:** Product added to a formulation to improve and optimize the effect of an active ingredient
4. Integrated Pest Management

This system includes all available methods or techniques, harmoniously combined, to bring pest populations below the economic damage levels or to prevent them from reaching that level. (Ramos, 2001)

To implement integrated pest management on farms, it is necessary to understand pest behaviour and life cycle and then determine the time when it is most susceptible to control or eradication.

Figure 31. Damage from *Colaspis*

Figure 32. *Colaspis* sp
4.1 Integrated Crop Management

Includes all of the above, but also considers:

- Location, type of soil and climate
- Seed / variety, resistance to pathogens and productivity
- Crop rotation
- Crop tilling
- Fertilization
- Crop protection

4.2 Integrated Farm Management

Addresses external factors:

- Organizational management
- Trade unions
• Social well-being
• Crop protection
• Relationship with environmental/sanitary authorities/institutions

4.3 Integrated Pest Management

Integrated management is based on three principles:

**PREVENTION**
Indirect measures that contribute to keeping pest populations low through the use of: trap crops, resistant varieties, crop rotation, irrigation and drainage, and natural controls.

**Observation**
Crop monitoring, forecast systems, prediction models. Pest presence and development is evaluated through inspections and use of traps.

**Intervention**
Application of measures that reduce pest populations, at the appropriate time and at the appropriate site. Different control methods intervene, such as:
Control Methods

Natural

Abiotic: Cold, heat, rain, wind
Biotic: Natural enemies, predators, parasitoids, pathogens

Artificial:

Exclusion: Prevent the entry of a pest
Eradication: Eliminate a pest present
Protection: Construction of barriers, construction of drainage, modification of soil pH.
Therapy: Control pest; prune; apply pesticides
Immunization: Modify plant physiology; develop resistant varieties
Legal: Laws, norms or legal provisions to prevent the entry of a sanitary problem to a region or country
Physical: Mechanical control; use of electricity, temperature, sound and ultrasound, bonders, and radiation
Ethological: Use of substances to modify pest behavior
Cultural: Use of agronomical practices
Biological: Use of natural enemies
Chemical: Use of pesticides
5. Use of Pesticides

Commonly used in:

- Agriculture.
- Harvested products.
- Cattle raising & farm breeding
- Human health

5.1 Formulation

A formulation is defined as the way in which a chemical product has been prepared for practical use. In its natural form, a substance may be formulated as a solid, liquid or gas. In general terms, formulations consist of an active ingredient and some additives.

Figures 35, 36 and 37. Pesticide formulations
5.2 Types of formulations

a. Solid formulations

Solid powders, SP: Form true solutions; easy to apply once diluted in water. Suspended in air, such powders could be aspirated or could come in contact with eyes and skin, causing irritation. As a solid added to a liquid, shake the mixture well to ensure dissolution.

Wettable powders, WP: Powder formulation, to be applied as suspension after dispersion in water. Requires premixing in pail to dissolve any lumps formed when the powder enters into contact with the water; stir constantly. Abrasive, these powders may clog sprayer filters and nozzles.

Water dispersible granules, WG: Formulation consisting of granules to be applied once disintegrated and dispersed in water. This formulation has the following advantages: more active ingredient may be concentrated, does not produce suspended particles in the air and requires less water for application than other formulations.

b. Direct application solids

Granules for direct application, GRs: Solid product consisting of an active ingredient in low concentration and an inert carrier. Special granular formulations
basically differ due to grain size. Undiluted, these are applied to foliage, on the ground, near roots.

**Application of powders AP:**
Powdered formulation ready to be applied undiluted. Differentiated as contact powder CP, dry powder and fine power (GP). Not to be mixed with water; easily suspended in air; abrasive to equipment.

**Toxic baits (Pellets) GB, RB:** Formulation designed to attract and be consumed by the target pest; different forms and denominations. It also contains the active ingredient and an attractant carrier; may come formulated, like rodenticides, or may be formulated on the farm by an active ingredient, generally an insecticide, a carrier like corn or wheat bran or sawdust and an attractant like molasses which is used to control mollusks, ants and rodents, among others.

**Direct-application tablets, DT:** Tablets for direct and individual application in the field, without preparation or spraying.
c. Liquid formulations

- **Soluble concentrations, soluble liquids or concentrated solutions, SL:** Defined as a liquid formulation, homogeneous, applicable as a true active ingredient solution once diluted in water. Since they form true solutions, they do not require constant stirring, but react easily with hard water (rich in magnesium and calcium carbonates) producing precipitates, where the water must be conditioned first.

- **Emulsifiable concentrates, EC:** Homogeneous liquid formulation to be applied as emulsion once diluted in water. Active ingredient, not water soluble, is mixed with water through the use of an emulsifier.

- **Ultra-low volume, ULV:** Products to be applied in small volumes by area unit.

- **Suspension Concentrate, SC:** Stable suspension of active ingredient in liquid for use once diluted in water. Shake mixture before and during use to form a suspension.

- **Capsule Suspension, CS:** Active ingredient is coated with a special polymer to form microscopic capsules. Microcapsules become suspended in water, so shake the mixture continuously. After application, the active ingredient is released through micro-pores and the extended biological action begins once the spray has dried out.
5.3 Mixes

Although some pre-prepared mixes are available in the market, farmers continue to make the so-called “tank mixes” using different types and formulations of pesticides and foliar fertilizers in order to reduce the number of applications, lower production costs, optimize spraying gear, reduce work time, and prevent mechanical crop damage due to worker and equipment traffic.

Therefore, several general considerations must be examined prior to producing a mix:

- Apply individual, highly efficient biological pesticides;
- Apply foliar fertilizers as separate salts to prevent precipitation;
- Better mixes result from combining pesticides with the formulation itself;
- A mix is as toxic as its lowest-category product; personal protection equipment and usage precautions must match that category.

5.4 Active Ingredient

Substance responsible for the biological effect of the pesticide.

- **Common or generic name**: Imazalil.
- **Chemical name:** (±)-1-(ß-alliloxi-2,4-dichlorophenylethyl), imidazol

- **Commercial name:** Fungazil, Magnate c.

**Additives**

Substances added to active ingredients to facilitate application, enhance action and avoid decomposition.

- **Solvents:** Hydrocarbons, alcohols, ketones
- **Carriers:** Kaolin, talcum, calcium carbonate
- **Surfactants:** Humidifiers, adjuvants, dispersants, detergents, emulsifiers.
- **Others:** Odorant, emetics, colorings
6. Handling Agro-inputs

6.1. Labeling

Pesticide labeling requirements provided in national and international legislation are mandatory both for imported as well as for national products.

Workers must follow all instructions related to use, preparation, application and recommended doses indicated on labels and safety data sheets.

Label

All written, printed or graphic materials on the pesticide container or printed, engraved or attached on its immediate container and outer packaging for use or distribution (Decision 436 Andean Norm).

The purpose of a label is to provide end users essential data, in clear and simple terms, to control harmful organisms and to use the product in the safest manner possible. Reading a label is of utmost importance. It lists the chemical contents, uses, risks, safe handling and what to do in an emergency. A label is a legal document. Pursuant to Law 123/91 and its regulations, Resolution 295/03 demands that pesticide manufacturers and
importers include specific information on product labels, which could consist of one, two, three or four panels (pesticide labeling document).

Figure 39. Complete label

Figure 40. Central label
Classification by Danger
Red Stripe Ia and Ib

Figure 42. Toxicological categories and labels
Remember that the first rule to identify a potentially toxic substance is to examine its label carefully.
World Health Organization (WHO) Classification

The World Health Organization (WHO) has recommended, subject to regular updates, a hazard classification, or the ability of a product to produce severe health damage due to exposure on one or more occasions in a relatively short time frame. This classification is based on the mean acute lethal dose (LD50), from oral or dermal contact on rats.

However, a product with a low mean lethal dose (LD50) may cause chronic effects from extended exposure.

**Table No. 1** Pesticide hazard classification

<table>
<thead>
<tr>
<th>CLASSES</th>
<th>ORAL</th>
<th>DERMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solids*</td>
<td>Liquids*</td>
</tr>
<tr>
<td>Ia Extremely hazardous</td>
<td>5 or less</td>
<td>20 or less</td>
</tr>
<tr>
<td></td>
<td>5 to 50</td>
<td>20 to 200</td>
</tr>
<tr>
<td>Ib Highly hazardous</td>
<td>50 to 500</td>
<td>200 to 2000</td>
</tr>
<tr>
<td></td>
<td>Over 500</td>
<td>Over 2000</td>
</tr>
<tr>
<td>II Moderately hazardous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III Slightly hazardous</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Physical status of ingredient or formulation classified

Three other groups of pesticides are:

a. **Group V:** Includes products that are not a major risk if used appropriately; oral LD50 equal or greater than 2000mg/Kg for solids, and equal or greater than 3000mg/Kg for liquids.

b. **Group VI:** Includes products not assigned to any category, as they are considered obsolete or whose use has been discontinued.

c. **Group VII:** Includes volatile or gaseous fumigants. The WHO classification has no criteria for concentrations in air. Mostly very toxic. Many countries have recommended occupational exposure limits.

**Pictograms**

These are illustrations that depict recommendations on pesticide handling and use.

**Storage pictogram**
Keep product locked and out of reach of children.
Handling Pictograms

Handling liquids

Spraying with equipment

Handling solids

Applying solids for direct use

Recommendation Pictograms

Use gloves

Use boots

Use facial protection

Use mask

Use breathing mask

Use overall

Use apron

Wash after use
6.2 Transportation

Decree 1609 of July 2002 regulates the handling and transportation of hazardous goods by land, indicating shipper and/or owner responsibilities, as well as related non-compliance sanctions.

Due to the nature of the cargo itself, pesticide transportation is a potentially hazardous task, prone to such contingencies as road accidents and spills. Therefore, all precautions are necessary to ensure the products arrive at destination without problems. (Memorias, 2004)

The following recommendations must be considered:
**Vehicles**

Transportation vehicles must be suitable to carry pesticides and must be in good mechanical conditions; tires, brakes, lights, chassis and steering system must be inspected. Avoid holes or cracks that could lead to water infiltration; avoid exposed nails, screws or splinters that could tear packaging or containers during transportation. (Ramos, 2004)

Pesticide transportation vehicles require permits issued by the sectional health authorities. (Decree 1843/91)

**Drivers**

Pesticide transportation truck drivers require training and information on the products carried and emergency procedures. Besides the bill of lading, drivers must carry written information, provided by the manufacturer or distributor, on product-related risks and precautions. (Ramos, 2004)

**Emergency Gear**

Vehicles must carry fire extinguishers suitable for the materials carried and the types of possible fires, first-aid kit with antidotes or appropriate medication to treat possible intoxications from the materials carried, personal protection equipment, danger signage, and materials to respond to eventual spills (Ramos, 2004)
Figure 44. Extinguisher, first aid kit, protection equipment and danger signs

**Transportation Norms**

Truck cabs must be separate from bodywork.

- Do not carry products without labels or with illegible labels.
- Do not carry pesticides evidencing leaks or spills. Ensure perfect condition of materials to be transported.
Do not place heavy goods on top of pesticides to avoid breaking or crushing containers.

**Safety Data Sheet**

Clear, simple, concrete summarized handling information as well as emergency instructions.

**Loading Recommendations**

Before shipping, consider the following:

- Distribute weight and volume in a uniform manner to ensure good travel stability.
- Balance cargo weight.
- Secure or tie down cargo correctly.

**Unloading Recommendations**

Before unloading, check safety documents.

- Physically inspect outside of vehicle for leaks, signs of impacts, wear, engine overheating, etc.;
- Avoid dropping materials on ground to prevent possible leaks;
- Unloading sites must be free of sources of heat or energy;
• Ensure that label matches product risks.

⚠️ **Incompatibility**

For storage and transportation, do not mix the following:

• Toxic materials and food products. Risk of food contamination and/or poisoning.
• Fuel and oxidants. Risk of igniting materials.

⚠️ **Emergency Procedures**

• Park vehicles, if possible, in a safe place, separate from houses or water sources like rivers, lakes, ponds and even drains.
• Take all measures indicated on the safety data sheet.
• Avoid possible fires:

  Turn off engine
  Do not smoke
  Avoid sparks from chaffing or blows with metal objects
  Do not use matches or lighters
  Do not place fire signs on the road
  Do not use lamps other than anti-explosion
  Directly or indirectly inform the local authorities
6.3 Storage

- Minimize risks to individuals, facilities and the environment;
- Be prepared to respond to eventual emergencies like spills or fires;
- Avoid product exposure to direct sunlight, high temperatures and humidity to ensure product integrity;
- Ensure product is used before expiration date.

Certain rules apply to pesticide storage sites and systems.

💡 **Warehouses**

- **Location:** Distant from offices, houses, resorts, schools, entertainment centers, shopping centers, supermarkets, restaurants.
- **Access:** Transportation vehicles, fire trucks and/or emergency vehicles.
- **Separate from:** Water sources and flood-prone areas.
- **Construction materials:**
  - Solid concrete or brick walls
  - Metallic-structure roof
  - Asbestos-cement tiles
  - Polished or waterproof flooring
  - Metallic doors
- Design should consider:
  - Spill contention levees
  - Drainage
  - Ventilation
  - Lighting
  - Sanitary facilities
  - Doors
  - Separation from offices

颇 Fire Prevention and Control:

- Store flammable products separate from non-flammable products or oxidants
- Do not smoke in warehouse
- Do not use candles or oil lamps
- Do not store fuel

颇 Spill Response Equipment and Materials

- Personal protection equipment: Gas mask, nitrile gloves, apron, rubber boots
- Absorbent materials: Hydrated lime, sand, sawdust
- Cleaning equipment: Flat shovel, cotton fiber, detergent, hypochlorite or caustic soda, waste disposal containers
- Identification, caution and restriction signs:
  - Restricted access: No animals or unauthorized persons, especially children
  - Keep area closed
- Remain indoors as least as possible
- No food or smoking in storage area
- No stacking outside limits; keep products away from walls and ceiling
- Keep labels visible on stacks
- Separate products by classes (herbicides, insecticides, fungicides)
- Keep storage area organized
- Keep products in their original containers
- Leave space for circulation

**Containers and Packaging**

Consider the following:

- Exclusive dedication
- Wear protection
  - Product segregation
  - Use pallets and shelving
  - Inspect products
- Stock turnover
- Partially used products
- Order and cleanliness
- Storage volume

Figure 45. Pesticide storage pallet
Downloaded from www.empresario.com.co
6.4 Preparation

The following recommendations must be considered when mixing agrochemicals:

- Dispense product according to technical recommendations and specifications on label.

- Use clearly calibrated dispensers and gauging meters. Fertilizer meters should be changed after purchasing a new brand since volumes and grain sizes change.

- Use adequate personal protection equipment as recommended on left hand side of product label.

- Use containers and receptacles in good conditions to avoid spills and leaks.

- Transport mixes in sealed containers to avoid spills and splatters.

- Use good quality water for mixtures. Do not use hard water with high iron and/or calcium contents, water from former riverbeds as it contains dissolved organic matter, which reduces the effectiveness of the active ingredient.

Compliance with Decrees 1843 of 1991 Art 90, 1443 of 2004 and the Andean Norm (Surplus Handling)
Figure 46. Recommended PPE to prepare agrochemicals

Pictograms for pesticide storage and handling

Figure 47. Pictograms on left side of label
6.5 Application

This consists of depositing a pesticide product or a mixture of products, at a pre-determined dose, on a target or object (insects, weeds, leaves).

Efficiency of an application depends on:

- **Appropriate product**: Related to product scope of action, mode of action, pest resistance to its mechanism of action, correct formulation and status of conservation.

- **Correct dose**: Amount of formulated product per hectare required to obtain the expected results.

- **Timeliness**: Refers to point of time in the development of a pest when it is most susceptible to the action of the product.

- **Good application**: Application which meets the parameters of coverage, uniform distribution, recovery and efficiency of operator.

Good application depends on the following recommendations:

- Use appropriate personal protection equipment, as recommended on pictogram on right side of label.

- Apply under favorable environmental conditions, good lighting and limited breeze.
- Do not apply products against wind.
- Do not apply on overcast or rainy days.
- Perform preventive maintenance to spraying equipment.
- Appropriately calibrate sprayers, check nozzle discharge, and keep records.
- Use appropriate product and dose recommended by company technical expert.

To minimize health risks during application:
- Place “no entry” warning signs on treatment plot
- Do not eat food while applying products
- Do not smoke while applying products
- Do not apply with recent wounds on body
- Use clean clothes each day.
- Wash work cloths on farm; do not take home.
- Wash hands after applying product and bathe, if indicated on label.
Application Recommendations and Environmental Hazards

Figure 48. Pictograms on left side of label

Figure 49. Sign at application site

☞ Pesticide Application Methods:

Spraying, broadcasting, granular, thermo-mist, gasification, drenching, immersion
By equipment type: Air and ground
By site: Open air or closed environment
By coverage area: Total, in-band, targeted, topical

6.6 Pesticide Residue and Waste Management

This encompasses pesticide residues and wastes, deteriorated or expired products, rinse waters, excess or spills, contaminated clothing, personal protection equipment and application gear, mixture surplus and empty pesticide containers. As a potential risk, these must be discarded in a manner that does not affect human health or the environment. (Memorias 2007)

Waste management recommendations

Expired or Deteriorated Products

Test recently-expired products on a small area. If control is positive and no plant toxicity occurs, use surplus as soon as possible. For older products and smaller amounts, add a solution of caustic soda or mix with lime, earth or sawdust and dispose of in an adequate waste site.

Contact the product manufacturer for larger expired lots. The manufacturer will determine if the product is still in good condition or out of specifications but still capable to be
reformulated for further use or not. Additionally, the manufacturer may destroy the product either through incineration or chemical treatment. If the manufacturer is not represented in the country (imported product), contact the sanitary authorities (ICA).

☞ Empty Containers

Containers for liquids, such as cans, metallic or plastic jugs and glass bottles must be decontaminated using triple wash or triple rinse.

☞ Triple Rinse

Consists of rinsing the agro-chemical container three times. For liquid formulations, fill container with 3/4 parts of water, cover and shake well. That rinse water, plus any residues, is emptied into the mixture can, spray pump, or used for the next treatment plot. This process is repeated on two more occasions. After perforating the container and its cover, and disposed of to avoid reuse.

Figure 50. Triple rinse scheme
Discarded containers must be stored in a safe place, under lock and key, where they cannot cause a risk to company personnel and the environment until final disposal.

**Excess Mixture**

Where possible, avoid excess product by accurately calculating the mix to use on a specific area. Calibrate the equipment well and calculate the amount of commercial product and volume required.

If the excess is more than 10% of the expected volume, re-dilute the surplus and apply to the area to avoid under-spiking, apply to another portion of crop or re-apply to portions with a major phyto-sanitary problem (foci).

**Rinse Water**

This results from washing application equipment, protection equipment, and from worker showers and sinks. This water drains to an agro-chemical trap with activated lime prior to final disposition.

**Spills**

Clean with absorbent materials (sawdust or sand), store in bags and later dispose of in a safe, open-air place to encourage product degradation through microorganisms, light, water and temperature.
Protection Equipment

Used protection equipment like gloves, boots, and impregnated filters must be destroyed and disposed of along with empty containers. Agro-chemical containers are collected from farms by several cooperatives accredited by the environmental authorities and later incinerated in steel plant furnaces outside the area. (Nobsa - Boyacá).
7. Toxicology Risk and Principles

7.1 Risk Definition
This is the likelihood of suffering an accident or getting ill from exposure to a potential causative agent.

For a risk to occur, a person must be exposed to a substance that represents a health hazard. Presence of both the hazard and the exposure are necessary, not just one.

![Figure 51. Potential Risk](image)

7.2 Risk Assessment
- Risk identification
- Dose assessment – Response
- Human exposure assessment
- Risk characterization

7.3 Risk Enhancement Factors
- Work long hours
- Use more toxic products
- Handle concentrated products
- Handle many different pesticides
- No or inadequate PPE

7.3 Risk Management Enhancement Factors

- How serious is the effect?
- How many individuals are at risk?
- Level of public concern
- Legal factors – regulations
- Cost-benefit analysis

Risk Management Process

Regulatory agencies determine and enforce exposure limits based on levels of acceptable risk. Such recommendations guide the use of PPE.

How is Risk Managed?

Education Technology Regulations

Figures 52, 53 and 54. Risk management methods
7.5 Basic Toxicology

Poison or toxic
A substance that, upon entering the organism, causes a state of illness or death through non-mechanical means.

Pesticide Risk
Depends on Degree of Toxicity x Degree of Exposure.

Toxicity
Degree at which a chemical substance has harmful effects on living organisms.

Exposure
Situation of effective or close contact of pollutant with an individual.

Dose
Amount of substance an organism is exposed to. Response depends on dose, which may be: negligible, effective, toxic or lethal.

Figure 54. Metering concept.
Origin of Intoxication

- Voluntary: when a person willingly ingests a toxic substance.
- Criminal: when another person administers the toxic substance.
- Accidental: when the toxic substance is ingested accidentally.
- Occupational: ongoing exposure to a toxic substance while working.

Figuras 55 y 56. Possible accidental intoxication

Fate of Toxic Substances
- Deposit in organs
- Bio-transformation
- Elimination

Figure 57. Organs targeted by toxics
Types of Effects
- Reversible or irreversible
- Local or systemic
- Acute or chronic

Immediate or Acute Effects
Result from short-term exposures and are expressed as:
- Headache
- Dizziness
- Nausea
- Watery eyes
- Respiratory irritation
- Loss of consciousness
- Convulsions

Figure 58. Immediate symptoms (acute)

Long-term or Chronic Effects
Repeated exposure over extended periods or time may:
- Delay in appearing
- Be difficult to describe
- Cause damage to organs and vital systems.
8. Bibliography

Convenio ANDI SENA. 2002. Uso adecuado y eficaz de productos para la protección de cultivos.

Manual de Plaguicidas, Guía para América Central. Instituto Regional de Estudios en Sustancias Tóxicas (IRET), Universidad Nacional, Costa Rica, 1999. e-mail: iret@una.ac.cr


9. Glossary

**HARD WATER**: contains high level of minerals, particularly **magnesium and calcium salts**, which make the water hard. The **degree of hardness** is directly proportional to the concentration of metal salts. Not suitable for use in pesticide preparations.

**ACTIVE INGREDIENT**: Biologically active component of the phytosanitary product present in a formulation. Synonyms: active material, active substance, active, technical product.

**FORMER RIVERBED**: name given by farmers to water sources or natural streams that run through a plantation.

**MICROCAPSULES**: small particles consisting of polymers that coat an active product; herbicide, **insecticide**, **fertilizer for direct application**.

**PATHOGEN**: any organisms capable of producing an illness.

**PICTOGRAM**: diagram that uses imagery or symbols to display information for rapid understanding.

**POLLUTION**: substances dispersed in air that produce adverse biological effects to human beings, economic activities or ecosystems.

**POST-HARVEST**: any activity undertaken after fruit harvest, selection, wash, treatment against diseases, packaging, transportation and distribution.

**PHYTOSANITARY PRODUCT**: defined by the **World Health Organization** (WHO) as a substance or mixture of substances.
destined to prevent the action of, or directly destruct, 
insects (insecticides), mites (miticides), mollusks, rodents 
(rodenticides), fungus (fungicides), nuisance weeds 
(herbicides), bacteria (bactericide antibiotics) and other 
forms of animal or plant life that are harmful to public 
health and to agriculture.

**SALINITY:** contents of sulfate and carbonate salts in the soil.
# 10. Index

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