MANUAL FOR THE INSTRUCTOR TO TRAIN GROWERS/FARMERS ON THE SAFE AND CORRECT USE OF PLANT PROTECTION PRODUCTS AND INTEGRATED PEST MANAGEMENT

AUTHOR: MANAGEMENT/IPM
AGR. ENG. CARLOS NEFTALI PALACIOS XUTUC
DESIGNS AND DIAGRAMS:
LUIS CARLOS PALACIOS DIAZ

PHOTOGRAPHS:
AMIFAC
BASF
BAYER
CARLOS PALACIOS
CIBA-GEIGY
CYANAMID
ICI
LACPA
LA TORRE, BERNARDO

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For further information contact:
SAFE AND CORRECT USE/IPM PROGRAMME
Agr. Eng. Anarco García
Regional Director
5ª Avenida 15-45 Zona 10
Centro Empresarial, Torre I, Of. 1008
Guatemala City – GUATEMALA
Tel.: +502-363-2229 / 363-2239
Fax: +502-333-7092
croplife-gua@terra.com.gt
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INTRODUCTION

One of the main objectives of CropLife is the development and enforcement of Education and Training programmes on the Correct Use and Management of plant protection products and Integrated Pest Management (IPM).

Since 1991, with this objective in mind, the first projects have been under way and, to date, they have been extended throughout several regions. This important contribution from the industry, has been of great benefit for the production process and the environment, and also to improve the knowledge of farmers and their families on the correct use of plant protection products and integrated pest management.

Knowing that our Education and Training programme has been accepted for a long time by governmental authorities, non-governmental organisations and producers associations, who need didactic material to fulfil their educational needs, this important manual has been prepared so that the interested parties can have a source of updated information to orient growers/farmers on how to protect their crops, their health, and the environment.

CropLife International developed this manual based on the experiences from a whole decade, in the process of training master trainers, technicians, growers/farmers, housewives, teachers and school children from rural areas, with the purpose that they orient farmers on Sustainable Agriculture practices.

This manual has eight units that go from Integrated Pest Management (IPM) to elimination of empty containers; pursuing with this that by applying correctly the knowledge they have acquired, farmers be able to achieve an abundant production of food and fibre, within a healthy, competitive and profitable production scheme, contributing this way to a sustainable development.

We are confident that this manual will be a real and effective contribution to rural development and that it will be broadly used by persons working in projects and programmes dedicated to this type of activity.
UNIT # 1

PRESENTATION OF THE COURSE
PRESENTATION OF THE COURSE

REVIEW

In recent years, farmers have seen the importance to make fundamental changes in the field to the production process. To take into consideration the health and the environment should be a social commitment. Farmers must look after their health and the health of the consumers and they should be trained to reduce any risks in the production process.

The main objective of this training course is to educate farmers on integrated pest management and the correct use of plant protection products, to increase farmers’ safety as well as the safety of the consumers and to reduce environmental risks derived from their use.

The training consists of the following aspects:

1. To transmit the knowledge to participating farmers
2. To have participants take part in the discussions, problem solution, team work and supervised practices, and
3. Active and direct participation of farmers in training meetings.

During this presentation, the fundamental study units of the course should be presented and the communication process among participating farmers, trainers and financing institutions must be initiated.

The presentation must cover the following points:

A. Officially inaugurating the course.
B. Formally introducing participants, trainers and special guests.
C. Distributing necessary material to develop the course.
D. Indicating the title and objective of the course.
E. A general explanation of the programme and work methodology.

OBJECTIVES

At the end of the course participating farmers should be able to:

- Say the title of the course and indicate its objective.
- Identify his fellow students, name of the trainer or trainers and financing institutions
EQUIPMENT AND DIDACTIC MATERIAL

- Course programmes
- Flip chart paper
- Cards with participants’ names
- Note books and pens
- Adhesive tape

TIME REQUIRED

30 minutes

Note for the Trainer: A representative of the supporting organisation should be invited to inaugurate the course. After inauguration, ask the participants to introduce each other one by one and to write their names on a card or paper. Distribute the stationery to start the programmed activity.

Write the title of the course on the board and mention its final objective. At this stage take some time to explain how this objective will be reached. With the programme on your hand, explain briefly the structure and content of the course.

Explain to the farmers that all of them can contribute to the desired success of the course by sharing their experiences and that their participation is very important.
UNIT # 2

GENERAL CONCEPTS:

2.1 PEST ORGANISMS
2.2 INTEGRATED PEST MANAGEMENT

CHAPTER 2
CHAPTER 2.1 – PEST ORGANISMS

CHAPTER REVIEW

Participating farmers must admit that in nature there is a variety of organisms and that these, in relation to human’s interests, may be classified as damaging, beneficial and indifferent organisms.

Then they will learn that damaging organisms are harmful and they are considered as pests when they cause economic damage. To manage any type of phytosanitary problem that affects their crops they should be able to identify and recognise the various pest organisms and also some beneficial organisms.

The titles of the main subjects are:
A. Biological diversity
B. Pest and beneficial organisms
C. Ways to identify and recognise pest organisms
D. Regional crops and their main pests

OBJECTIVES

At the end of the course the participant farmer will be able to:
- Identify and recognise the diversity of organisms that exist at his place of work
- Identify and recognise pest and beneficial organisms existing in his crops
- Relate some symptoms and damage found in his crops with a possible phytosanitary problem (harmful organism), and
- Mention the name of some pests found in their crops and indicate where they are located; how do they look like; what do they eat, etc.

TIME REQUIRED:

60 minutes

STEP No. 1 – PRESENTATION – BIOLOGICAL DIVERSITY

In nature there is a variety of organisms: insects (adults or immature); mites (adults or immature); fungus, bacterium, virus, nematodes, weeds, rodents, birds, etc. Some of them have economic interest to man because they are harmful; others are beneficial because they are predators, parasites and/or pathogens of them.

Note for the Trainer: Take to the classroom some samples of live organisms or some illustrations. Explain some of the differences and relations among them.
BIOLOGICAL DIVERSITY

STEP No. 2 – PRESENTATION: PEST AND BENEFICIAL ORGANISMS

Organisms that are harmful and cause economic damage to crops, domestic animals, health and other human’s interests are called pests. Those organisms that help in a natural and/or managed way to regulate the population of harmful organisms, are called beneficial organisms or natural enemies.

Message for the Trainer: Use the same samples and separate harmful organisms from beneficial organisms. Explain some differences. Some illustrations or other resources can also be used. Mention other examples for each case.
HARMFUL AND BENEFICIAL INSECTS

HARMFUL:
1. Cotton bollworm
2. Cotton borer
3. White Fly

BENEFICIAL:
1. Carabid (predator)
2. Lady bug (predator)
3. Trichogramma sp. (parasitoid)
HARMFUL AND BENEFICIAL PATHOGENS

HARMFUL:
1. Bacteriosis in tomato
2. Club root of crucifers
3. Potato X potex virus

BENEFICIAL:
4. White grub (Bacillus popilliae infectanas)
5. Berry borer (White muscardine fungus)
6. Trichoplusia (ni = ni moth)
STEP No. 3 - PRESENTATION: HOW TO IDENTIFY AND RECOGNISE THE VARIOUS PEST ORGANISMS

Harmful insects are one of the most common pests but they are not the only ones that damage crops. There are other organisms that can reach a pest condition. Among them we can find pests, bacterium, virus and nematodes; all of them are commonly called pathogens. They are also found in weeds, rodents and birds.

Notions about insects: In nature, insects are very abundant organisms. Their body is divided in head, thorax and abdomen. They have in the head a couple of antennas, a couple of eyes and the oral device. Some insects are characterised by a pair of wings in the thorax; and some do not have any; in that same region of the body three pairs of legs are located.

Note for the Trainer: Use insect illustrations where their morphology is indicated so participant farmers can observe them.

MORPHOLOGY OF AN INSECT: BACK VIEW
(A) Eyes, (B) Front wings, (C) Back wings, (D) Antenas, (E) Legs, (F) Prothorax, (G) Mesothoraxic legs, (H) Mesothorax, (I) Metathoraxic legs.
INSECT MORPHOLOGY: (A) VENTRAL SIGHT, (B) LATERAL SIGHT
Notions about Mites: Most mites are very small organisms that are almost at the limit of human vision; they have been historically known by man since ancient times. However, it is until the last decades when their importance as disease vectors has been recognised and also as being responsible of the sanitary problems that affect man and domestic animals and, on the other hand, as farming pests of great importance. Due to their animal nature, mites have a great adaptation capacity that lets them live in the most varied habitats, that go from polar to the most tropical conditions in the whole planet; in deserts as well as in rivers, lakes, thermal fountains and marine depths.

As ectoparasites of vertebrates, mites are frequently found in bird feathers, mammals’ hair; on reptiles and often associated to insects. But they are not only seen as ectoparasites, it is also possible to see them as endoparasites, living in the respiratory channels; drilling under the skin and even in internal organs of various animals.

In the plants they can live in all aerial parts, where they can attack the leaves’ surface, live from the buds’ young tissues or form galls. They can also live from the plants’ underground parts and from stored products. On the other side, as free life animals they abound in rich organic matter; in trees, on the ground and in humid environments.

In spite of their great abundance and enormous distribution, mites are little known by man due to their small size. However, some of them, like ticks and plower of the scab, have been known for a long time due to their large size and the discomfort they cause to domestic animals and man.

Many mites seem to have only one segment in all the body; others look as if they have it divided in two parts and others seem to have the body widely segmented or with rings.

All mites are oviparous, even if in some cases the eggs can be incubated inside the mother’s body and furthermore, in extreme cases they can complete their development and get out to the exterior being adults.
MITES MORPHOLOGY AND METAMORPHOSIS:  
(A) EGG, (B), (C) AND (D) NYMPH STAGE, (E) ADULT

Notions about other arthropods: Insects are classified in a larger group than invertebrates and they are nominated arthropods. There are some organisms that look like insects but they are not insects, among them are found the centipede, millipede, spiders, mites, woodlouse, and other crustacean (crabs, shrimps, lobster, etc.)

Note for the trainer: Use illustrations with these arthropods and show the different regions in which its body is divided and other specific morphological characteristics.
OTHER ANTHROPODS:
(A) CENTIPEDE, (B) WOOD LOUSE, (C) SPIDER,
(D) TICK, (E) MILLIPEDE
Notions about insect development and metamorphosis: During the development and growth of insects, as well as frogs and toads, they suffer various changes. This development occurs within a rigid structure called exoskeleton; for that reason, every time they need to grow, they change skin (exoskeleton). That change is denominated moulting, and the number of changes until they reach the adult stage is called metamorphosis. There are two types of metamorphosis: Simple metamorphosis and complete metamorphosis. During the simple metamorphosis the insect go through the stages of egg, nymph and adult. During the complete metamorphosis, through the stages of egg, larva, pupa and adult.

Note for the trainer: Use insect illustrations with various types of metamorphosis; if possible, take with you some live samples. The attached illustrations may be used.
THRIPS SIMPLE METAMORPHOSIS
(A) EGGS, (B) NYMPHS (C) ADULTS
BUG COMPLETE METAMORPHOSIS:
(A) EGG, (B), (C) Y (D) LARVAE, (E) PUPAE, (F) ADULT

FLY COMPLETE METAMORPHOSIS:
(A) EGG, (B) LARVA, (C) PUPA, (D) ADULT
ROOTWORM COMPLETE METAMORPHOSIS
(A) EGG; (B) A (F) LARVA STAGE, (G) PUPA, (G) ADULT
Notions about insect eating habits: Insects food is diverse. Some eat vegetable parts (roots, stems, leaves, flowers and fruit); others eat vegetable sap. Other insects nourish from man and domestic animals blood, transmitting diseases while they eat. There are also insects that damage man’s buildings and clothes; also, there are some insects that consume their own specie (predators and parasites). These varied types of food explains why insects have such a broad variety of oral devices, each one is special either for chewing, sucking, scraping, cutting, etc.

Note for the trainer: Use illustrations of insects nourishing from various sources. Also illustrate various types of oral devices. Have farmers participate; ask them to give some examples. Elaborate a list of them.

<table>
<thead>
<tr>
<th>TYPES OF INSECT ORAL DEVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) SYPHON TYPE, (B) CHEWER, LICKER, (C) SUCKER, SCRAPER, (D) FLUFFY (E) CHEWER</td>
</tr>
</tbody>
</table>
HARMFUL INSECTS

1. Banded beetle
2. White fly
3. Aphid
4. Grass hopper
5. Banded beetle larva
6. Onion fly larva
7. Thrip nymphs
8. Rice weevil
9. Gusano medidor
10. Potato jumping flea
11. Rice sogata
12. Whitegrub
13. Wire worm
14. Leafhopper
Summary: There are several kinds of arthropods: Centipede, millipede, spiders, mites, wood louse, and other crustacean. Insects have their body divided in three parts; they might or might not have wings; a pair of antennas and one pair of compounded eyes. They have three pairs of legs. During their growth and development suffer a metamorphosis. They eat diverse food and have specialised their oral device according to the type of food they eat.

Note for the trainer: End here everything related to insects. Ask questions to the participants and start the evaluation process, either oral or written.

Notions about pathogen organisms and plant diseases: Phytopathogens are micro-organisms that affect the normal development of plants, causing them diseases. A disease is defined as the group of symptoms that affect the normal growth and development of plant. Plant diseases are divided in two groups:

A. Plant non-parasitic diseases. These diseases are not caused by live organisms. They are caused by excess, lack or deficiency of several factors necessary for the normal development of a plant. For example: Too high or too low temperature; nutritional deficiencies; phytotoxicity of some agrochemical products. Lack or excess of water.

B. Plant parasitic diseases. These diseases are caused by live micro-organisms called Pathogens that live in plants and feed themselves from them. These diseases are transmitted from one plant to the other. They occur when various factors are present: Presence of the pathogen agent; a guest plant sensible to it and environmental conditions appropriate for disease symptoms to develop.

In nature there are various micro-organisms that produce plant diseases. Next there are some of them:

Notions about fungus: Fungi are micro-organisms that do not produce their own food. Some absorb food from organic waste or dead organisms, while others are parasites that absorb food from their hosts live bodies. Although the species that provoke diseases and destroy crops and goods stored by man have given the fungus a bad reputation, the truth is that these organisms contribute in a significant way to nature ecological equilibrium. In conclusion, not all fungi are harmful: some are beneficial to man. Among the fungus that can provoke plant diseases are rusts, carbons, ashes, blights, etc.

Notions about bacteria: Bacteria are unicellular micro-organisms that cannot be observed at a glance, although some times they form colonies. Bacterium may cause plant diseases and can multiply very fast, causing damage. The rottenness they provoke is soft, sticky and foul-smelling.
Notes about virus. Viruses are entities located in the threshold that separates what is alive and what is not. They are not cellular beings; they do not move by themselves and are not capable of developing their own life in an independent way. In a sense, it can be said that virus are alive only when they have infected another organism. Viruses are pathogens that cannot be seen at a glance and are transmitted to healthy plants very easily. Sick plants remain small, with curly leaves and with mosaics.

Notions about nematodes: Nematodes or round worms are very small cylindrical worms that live agitating in the soil particles, constantly rolling and unrolling. Although some of them have a free life, others are important parasites of plants and animals. Some damage the roots and aerial part of the plants. They usually do not kill the plant but can reduce their yield. The roots of sick plants show galls, superficial necrosis of the roots, and malformation of the roots end, rottenness and other symptoms that can be taken for the ones caused by a virus.

Nematodes that nourish from the root do it from outside the root and they are denominated ectoparasites and the ones that penetrate the host tissues are denominated endoparasites and they nourish from internal cells. The latter divide into migratory endoparasites because they constantly change place inside the plants tissue and sedentary endoparasites because they stay in only one place. It must be clarified that there might be phases in an endoparasite life cycle in which the nematode nourishes in an ectoparasitic form and vice versa. Ground nematodes can be grouped as follows:

A. Saprophytes, that nourish from decomposed organic matter.
B. Predators, that nourish from small animals, including other nematodes.
C. Phytoparasites, that nourish from the plants.

Xiphinema female          Pratylenchus female
ANATOMY AND MORPHOLOGY OF A PHYTOPARASITIDE NEMATODE
Frequently, various plant pathogens may cause similar damage; for this reason, it is difficult to recognise one disease from the other with the same symptoms. Chart No. 1 “Some symptoms found in plants and possible causes of phytosanitary problem”, can orient on this regard. However, it is always recommended to ask advice from a specialist to obtain a good diagnosis.

Note for the trainer: Aid yourself with illustrations and show the participants the symptoms related with the problem that provoke them. Take to the classroom samples of sick plants and identify related symptoms. Ask farmers to observe and exam the sick plants or organise a walk across the field.
DISEASES CAUSED BY HARMFUL FUNGUS

1. Septoriosis
2. Moniliasis
3. Banana’s crown rottenness (various pathogens)
4. Cereals’ root disease
5. Botritis
6. Cercosporiosis in coffee
7. Rust spot in coffee
8. Powdery mildew in roses
9. Venturia, Apple spots
10. Sclerotinia, White mould in legumes
11. Cercosporiosis in peanuts
12. Piricularia or rice burn
DISEASES CAUSED BY HARMFUL BACTERIA

1. Agrobacterium tumafaciens
2. Pseudomonas solanacearum
3. Bacteria withering
   Clavibacter michiganensis
4. Necrobiosis of vascular tissue,
   Clavibacter michiganensis
DISEASES CAUSED BY HAMFUL VIRUS

1. Common mosaic in bean
2. Tomato virus
3. Golden mosaic in bean
4. Yellow dwarfing in barley
5. Virus of watermelon mosaic
6. Rolling of potato leaf
7. Virus “X” in potato
HARMFUL NEMATODES AND DAMAGE THEY CAUSE

1. Damage caused in potato by golden nematode
2. Roots damaged by nematodes
3. Beet nematodes
4. Meloidogyne nematodes in coffee roots
### CHART No. 1

**SOME SYMPTOMS FOUND IN PLANTS AND POSSIBLE CAUSE OF THE PHYTOSANITARY PROBLEM**

<table>
<thead>
<tr>
<th>SYMPTOMS:</th>
<th>POSSIBLE CAUSES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galls</td>
<td>Insects and mites</td>
</tr>
<tr>
<td></td>
<td>Fungus and bacteria</td>
</tr>
<tr>
<td></td>
<td>Nematodes</td>
</tr>
<tr>
<td>Chlorosis</td>
<td>Deficiency or excess of nutrients</td>
</tr>
<tr>
<td></td>
<td>Chlorophyll inhibiting herbicides</td>
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<tr>
<td></td>
<td>Virus and mycoplasm</td>
</tr>
<tr>
<td></td>
<td>Pathogens + toxins</td>
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<tr>
<td></td>
<td>Root rottenness</td>
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<tr>
<td></td>
<td>Root Nematodes</td>
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<tr>
<td></td>
<td>Lack of air on soil (compact soil)</td>
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<td></td>
<td>Stony ground (fruit trees)</td>
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<tr>
<td></td>
<td>Low content of organic matter</td>
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<tr>
<td></td>
<td>Bad drainage</td>
</tr>
<tr>
<td>Development of diverse leaf</td>
<td>Weather conditions</td>
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<tr>
<td>pigmentation</td>
<td>Soil conditions</td>
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<tr>
<td></td>
<td>Insects</td>
</tr>
<tr>
<td></td>
<td>Fungus and bacteria</td>
</tr>
<tr>
<td></td>
<td>Virus and mycoplasm</td>
</tr>
<tr>
<td></td>
<td>Nutrient excess or deficiency</td>
</tr>
<tr>
<td></td>
<td>Mechanical or toxic damage</td>
</tr>
<tr>
<td>Dwarf plants</td>
<td>Virus and/or nematodes</td>
</tr>
<tr>
<td></td>
<td>Inconstant humidity availability</td>
</tr>
<tr>
<td></td>
<td>Bad drainage</td>
</tr>
<tr>
<td>Problem Description</td>
<td>Possible Causes</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Witches broom disease</td>
<td>Mites</td>
</tr>
<tr>
<td></td>
<td>Virus and mycoplasm</td>
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<tr>
<td></td>
<td>Fungus</td>
</tr>
<tr>
<td>Aborted flowers</td>
<td>Deficient pollination</td>
</tr>
<tr>
<td></td>
<td>Fertilisation: deficient or unbalanced</td>
</tr>
<tr>
<td></td>
<td>Temperature (high and/or low)</td>
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<tr>
<td></td>
<td>Growth regulators</td>
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<tr>
<td></td>
<td>Insects</td>
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<tr>
<td></td>
<td>Excessive rain or strong winds</td>
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<tr>
<td></td>
<td>Phytotoxicity</td>
</tr>
<tr>
<td>Gummosis</td>
<td>Mechanical damage</td>
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<tr>
<td></td>
<td>Insect damage</td>
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<tr>
<td></td>
<td>Fungus and bacteria</td>
</tr>
<tr>
<td>Leaves with holes</td>
<td>Insects</td>
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<tr>
<td></td>
<td>Fungus</td>
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<tr>
<td>Leaves with spots</td>
<td>Mites and insects</td>
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<td></td>
<td>Virus</td>
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<td></td>
<td>Fungus</td>
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<tr>
<td>Leaves with stains</td>
<td>Fungus</td>
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<tr>
<td></td>
<td>Bacteria</td>
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<td></td>
<td>Toxic matter</td>
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<tr>
<td>Cut leaves</td>
<td>Insects</td>
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<tr>
<td>Frog leg (branch proliferation)</td>
<td>Virus</td>
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<tr>
<td></td>
<td>Herbicides</td>
</tr>
<tr>
<td>Condition</td>
<td>Causes</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Withering</td>
<td>Dry land, Excessive soluble salts, Root rottenness, Nematodes, Vascular fungus, Vascular bacteria, Excessive water, Insects</td>
</tr>
<tr>
<td>Rottenness</td>
<td>Bacteria and fungus</td>
</tr>
<tr>
<td>Adventitious roots</td>
<td>Interference with translocation at ground level or deeper, Water stress, Radical rottenness, Nematodes</td>
</tr>
<tr>
<td>Damping-off.</td>
<td>Ground fungus, Insects, Soluble salts, Water saturated soil (bad drainage), Space problems for roots to grow</td>
</tr>
<tr>
<td>Descendent death</td>
<td></td>
</tr>
<tr>
<td>Blights</td>
<td>Fungus, Icy weather</td>
</tr>
</tbody>
</table>
**Notions about weeds:** Weeds constitute another pest organism that can harm crops. Weeds are plants that do not belong where they grow. These plants cause problems because they absorb nutrients, compete for light, water and space, which are also needed by crops. Besides, they serve as hosts of harmful pathogens and insects and can reduce crops quality and yield. Weeds have life cycles that vary from one to several years. According to their life cycle, they are grouped in annual, biannual and perennial.

A. **Annual.** These types of weeds have a one-year life cycle; they can be grass or broad leaf.
B. **Biannual.** These weeds last two years and grow from a seed. Their roots are thick and have mixed foliage.
C. **Perennial.** They last for several years, but lose their leaves at certain periods. There are various types and sizes of perennial weeds.

**Note for the trainer:** Take to the classroom three types of weeds or use some illustrations to show to the farmers. Ask them to mention the names by which they know them.

**Notions about rodents and birds:** Some superior organisms can become pests; rodents and birds can destroy and eat the crops. Many times they also eat and damage the plants already cultivated.

A. **Rodents,** such as mice and rats eat cultivated and stored grains. These animals constitute a danger to human health because they get food contaminated or dirty. Mice and rats are rodents with long tail and a body covered with hair. They are very skilful to climb and swim. Their favourite habitat is around drainage and water sewerage because they need to drink water every day. Rats and mice use their teeth to bite and chew. Signs left by rodents include feet and tail tracks; trails traced in the weed and ground; small and humid excrement with a brilliant black colour; marks of bites and an unpleasant smell that comes from the damaged grain. Rodents have become important field pests in some crops, such as sugar cane and rice, where they not only produce physical damage but also rottenness due to the injuries they cause.

B. **Birds:** Same as rodents, birds contaminate our food, reducing their amount and quality. Birds may cause severe damage to grain, fruit and vegetable crops. The signs of damage are pecks, feathers and excrement.

**Note for the trainer:** End the presentation making a resume. Then organise working groups so the farmers can discuss the subject “Regional crops and their main pests”. After the discussion, ask them to present a report. Motivate them and try to have everybody participate.
BIRDS

RODENTS

WEEDS

OTHER PEST ORGANISMS
CHAPTER 2.2
ELABORATION OF AN INTEGRATED PEST MANAGEMENT PROGRAMME AND DECISION TAKING

CHAPTER REVIEW

In this workshop the participants must accept that only harmful organisms that cause economical damage are considered as pests. To discover at what moment they reach this stage, it is necessary to keep an eye on each phenological stage through sampling. Participants should learn that sampling is a working tool that will help to take handling decisions when a pest attack occurs. They should also recognise that there are different forms to control pests and that it is important to consider possible management alternatives before choosing a chemical alternative. They should understand that a chemical type alternative is just another component within integrated pest management which should be used in a rational way.

Titles of main subjects:
A. Crop Phenology
B. Pest sampling for diagnostic and decision taking
C. Alternatives for pest handling
D. Integrated pest management

OBJECTIVES

At the end of the activity the participants will be able to:
- Identify the various phenological stages of the crop
- Identify the critical stages of the crop phenology and its key pests
- Perform a pest sampling
- Know and mention various alternatives of pest management
- Know and practice integrated pest management

REQUIRED TIME

Two (2) hours
STEP No. 1 – PRESENTATION:
CROP PHENOLOGY

During their development process all plants go through different growing stages. If a bean plant is taken as example, we notice that this begins germinating, continues emerging, primary leaves, first definite leaf, third definite leaf, pre-flowering, flowering, pod forming, pod filling and ripeness. Each of these stages can be influenced (accelerated or slowed) by climatic conditions and the site where is developing. All this is known as phenology. It is important to know the various phenological stages of a plant and identify during each stage the phytosanitary problems (pests) that are damaging the plant. Likewise, it is useful to know how all these pests are regulated by biotic and abiotic factors from the environment in which they develop. When all interrelations from a crop are known well, it is possible to be able to restructure a proper integrated pest management plan.

Message for the instructor: Give to each participant drawings that illustrate the phenological stages of the most important crops in the region. Ask them to write down on the drawings, the most important phytosanitary problems (pests) for each phenological stage. Ask the participants how climatic changes influence in the presence of certain pests. Ask them about several crop varieties. Make the students participate with their experiences.

**PHENOLOGY OF THE BEAN CROP**
STEP No. 2 – PRESENTATION:  
PEST SAMPLING FOR DIAGNOSTIC AND DECISION TAKING

Organisms sampling is an activity that must be realised in each crop phenological stage, since it will allow supervising the population dynamics of beneficial and damaging organisms and it will be the basis to take rational decisions. All crops have organisms that will never become a pest, because the populations that develop do not cause important economic damage. For that reason, before recommending chemical control for an existing pest, it is necessary to recognise its “economic threshold”, that is, the organism’s population that will cause a damage superior to the cost of its chemical control. This is done through a sampling practice.

Message for the instructor: Use illustrations with the phenological stages of crops from the region. Establish on them the various pests that attack those crops. Define the critical stages and key pests. Prepare charts that include phenological stages, pest organisms by phenological stage, sampling frequency, sampling size, economic damage threshold. Remember that economic thresholds vary from one country to the next and even in the same country there are various climatic changes, pests, crops, value of products and crops and, therefore, local levels should be applied. Make a field sampling practice. Get the help of various models or types of traps. Use the material included in this manual.

STEP No. 3 – PRESENTATION:  
ALTERNATIVES TO HANDLE PEST POPULATION

Once the economic importance of an organism pest population has been determined, it is necessary to formulate a series of questions before making an intelligent decision: Which is the best way to solve a pest problem in a safe and economic manner? What handling alternatives or tactics exist to solve a pest problem? Is it necessary to use a chemical alternative? Can the pest problem be solved using other means that may present a lower risk? Etc.

It is very important to recognise that there is a variety of alternatives and tactics for pest control, which can be used by the participants, alone or combined. These alternatives are grouped in those tactics used to prevent the pests (indirect measures) and the tactics used to attack the pests or that intervene to reduce to acceptable levels pest populations present in the crops, which are economically damaging (direct measures). In a general way, among the indirect measures that can be mentioned are the following: Site of the crop, crop rotation, healthy and good quality seed, which has been properly treated; crop distribution; resistant varieties; crop handling, fertilization, irrigation, habitat handling, trap crops, intercrops, harvest and storage. Among the direct measures we can mention: physical or mechanical control, ecological control, biological and chemical control.

Message for the Instructor: Use illustrations of the varied control alternatives. Ask the participants to offer examples of control methods they know about. Complete the “Alternatives” column in the chart that is being elaborated.
BEAN: INSECT PESTS THAT HARM THE CROP IN ITS PHENOLOGICAL STAGES

1. Black cut worm (Agrotis spp)
2. Borer (Elasmopalpus lignosellus)
3. Snail (Sarasinula plebeia)
4. Banded beetle (Diabrotica spp.)
5. Army worm (Spodoptera spp., Estigmene acrea)
6. Green leafhopper (Empoasca loraemen)
7. White fly (Bemisia tabaci)
8. Bean pod weevil (Trichapion godmaru)
9. Bean weevil (Helicoverpa zea)
### MAIN BEAN PESTS: SAMPLING AND CRITICAL LEVELS

<table>
<thead>
<tr>
<th>GERMINATION TO 2 TRIFOLED LEAVES</th>
<th>SAMPLING FREQUENCY</th>
<th>SAMPLE SIZE</th>
<th>CRITICAL LEVELS</th>
<th>BIOLOGICAL ALTERNATIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>White grub</td>
<td>(1) Before sowing</td>
<td>(1) 25 holes of 30x30x20 per ha.</td>
<td>(1) In 25 holes, 6 large larvae or 12 small.</td>
<td></td>
</tr>
<tr>
<td>Black cutworm</td>
<td>(2)</td>
<td>(2) (3), (4), (5), (6), (7), (8), (9) y (10)</td>
<td>(2) 5% of cut plant.</td>
<td></td>
</tr>
<tr>
<td>Rootworm larvae</td>
<td>(3)</td>
<td>(10) Ten plants per site in ten sites.</td>
<td>(3) and (4) 5% of damaged plants</td>
<td></td>
</tr>
<tr>
<td>Borer larvae</td>
<td>(4)</td>
<td>(4) (5) 100 adults</td>
<td>(4) Metarhizium</td>
<td></td>
</tr>
<tr>
<td>No. adults leafhopper</td>
<td>(5)</td>
<td>(6) 13 army worms/100 plants</td>
<td>(5) Bacillus popilliae</td>
<td></td>
</tr>
<tr>
<td>No. army worms</td>
<td>(6)</td>
<td>(7) 50 adults/100 plants</td>
<td>(6) Bacillus thuringiensis</td>
<td></td>
</tr>
<tr>
<td>No. adult banded beetle</td>
<td>(7)</td>
<td>(8) ------------</td>
<td>(7) Nematodes</td>
<td></td>
</tr>
<tr>
<td>No. white fly</td>
<td>(8)</td>
<td>(9) 0.5/sq. mt.</td>
<td>(8) Bees</td>
<td></td>
</tr>
<tr>
<td>No. Snails</td>
<td>(9)</td>
<td>(10) Determine disease presence</td>
<td>(9) CHEMICALS:</td>
<td></td>
</tr>
<tr>
<td>Soil diseases:</td>
<td>(10) Damping off</td>
<td></td>
<td>(10) An authorised chemical</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CULTURAL:</td>
<td></td>
</tr>
<tr>
<td>FROM 2 TRIFOLED LEAVES TO FIRST PODS</td>
<td>Twice a week for all</td>
<td>(1), (2), (3) y (6) Monitor 10 trifoliate leaves per site</td>
<td>(11) Crop rotation</td>
<td></td>
</tr>
<tr>
<td>Pupae leafhopper</td>
<td>(1)</td>
<td>4) and (5) Monitor 20 flower buds and 20 pods per site</td>
<td>(2) Stubble management</td>
<td></td>
</tr>
<tr>
<td>Number of rootworm larvae</td>
<td>(2)</td>
<td></td>
<td>(3) PLANT BREEDING</td>
<td></td>
</tr>
<tr>
<td>Number of white fly</td>
<td>(3)</td>
<td></td>
<td>(4) Resistant varieties</td>
<td></td>
</tr>
<tr>
<td>No. of pods with presence of bean pod weevil</td>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of snails</td>
<td>(5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of army worms</td>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of bean pod weevils</td>
<td>(7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diseases:</td>
<td>(8) Damping off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Damping off</td>
<td>(9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foliage diseases:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Powdery mildew</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Downy mildew</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Rust</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POD FILLING UNTIL RIPENING</td>
<td>Three times a week</td>
<td>(1) 200 per 100 leaves.</td>
<td>(1) Soil diseases:</td>
<td></td>
</tr>
<tr>
<td>Number of bean pod weevils</td>
<td>(1)</td>
<td>(2) 100 per 100 leaves</td>
<td>(2) Damping off</td>
<td></td>
</tr>
<tr>
<td>Number of pods with bean pod worms</td>
<td>(2)</td>
<td>(3) ------------</td>
<td>(3) Foliage diseases:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) 10 of 200 pods</td>
<td>- Powdery mildew</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5) 0.5/sq. mt.</td>
<td>- Downy mildew</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6) 15 of 100 leaves</td>
<td>- Rust</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7) ------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8) y (9) Determine disease presence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>(10)</td>
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<tr>
<td></td>
<td></td>
<td>(11)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CRUCIFERS: INSECT PESTS THAT HARM THE CROP IN ITS PHENOLOGICAL STAGES

1. White grub (Phyllophaga spp.)
2. Black cut worm (Agrotis spp.)
3. Diamond black (Plutella xylostella)
4. Bugs (Diabrotica spp.)
5. Army worm (Spodoptera spp. A. Monistes and L. arpia)
6. Aphids (Brevicoryne brassicae)
7. Cabbage looper (Trichoplusia ni)
# MAIN PESTS FROM CRUCIPHERS: SAMPLING AND CRITICAL LEVELS
## CABBAGE, BRÓCOLI, AND COLIFLOWER

<table>
<thead>
<tr>
<th>SEEDLING STAGE</th>
<th>FREQUENCY OF SAMPLING</th>
<th>SAMPLE SIZE</th>
<th>CRITICAL LEVEL</th>
<th>ALTERNATIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Black cut worms</td>
<td>(1), (2), (3) and (4) Twice a week.</td>
<td>(1), (2), (3) and (4) Three sites per seed nursery bed and 10 plants per site.</td>
<td>(1) and (2) Three cutworm or diamond black larvae per every 30 plants.</td>
<td>(1) and (2) BIOLOGIC: - Bacillus thuringiensis</td>
</tr>
<tr>
<td>(2) Diamond black</td>
<td></td>
<td></td>
<td>(3) 9 banded beetle adults per every 30 plants.</td>
<td>(2) and (4) CHEMICAL: - An authorised chemical.</td>
</tr>
<tr>
<td>(3) Rootworm</td>
<td></td>
<td></td>
<td>(4) 15 winged Aphids or 12 colonies.</td>
<td></td>
</tr>
<tr>
<td>(4) Aphids</td>
<td></td>
<td></td>
<td>(5) Determine presence of sick plants.</td>
<td></td>
</tr>
<tr>
<td>(5) Diseases: - Damping off - Bacteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## ESTABLISHMENT TO HEAD PREFORMATION
| (1) Whitegrub | (1) Sample before transplanting. | (1) 25 sites/ha., 30x30x20 holes. | (1) 6 large larvae or 12 small. |
| (2) Black cut worm | (2) to (7) Continue sampling twice a week. | (2) to (7) Three sites of 10 plants each. | (2) Two plants cut from 30 observed. |
| (3) Rootworm | | | (3) 9 adults from 30 plants. |
| (4) Aphids | | | (4) 15 winged aphids or 12 colonies from 30 plants. |
| (5) Diamond black | | | (5), (6) y (7) 3 larvae from 30, in cabbage and 9 larvae from 30 plants observed in broccoli and cauliflower |
| (6) Army worm | | | (8) Six larvae of cabbage looper from 30 plants observed, in cabbage, broccoli or cauliflower. |
| (7) Cabbage caterpillar | | | (9) Determine presence of sick plants. |
| (8) Cabbage looper | | | |
| (9) Diseases: - Black spot - Powdery mildew - Downy mildew - Bacteria | | | |

## HEAD PREFORMATION AND HEAD FILLING
| (1) Aphids | (1) to (6) Same frequency of sampling. | Same size as the sample. | (1) 15 winged aphids or 12 colonies. |
| (2) Diamond black | | | (2) at (5) Three larvae from 30 plants, either from broccoli, cauliflower or cabbage. |
| (3) Cabbage looper | | | (6) Determine presence of sick plants. |
| (4) Army worm | | | |
| (5) Cabbage caterpillar | | | |
Integrated Pest Management (IPM) is a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilises all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economically unacceptable damage or loss. For farmers and pest control operators, IPM is the best combination of cultural, biological and chemical measures that provides the most cost effective, environmentally sound and socially acceptable method of managing diseases, insects, weeds and other pests under the circumstances in which they work.

Therefore, an elementary principle of effective IPM is to develop strategies taking into account all relevant control tactics, and methods available locally. The successful user of IPM will evaluate the potential cost effectiveness of each alternative as well as the whole control strategy.

IPM requires three competence areas: Observation, Prevention and Intervention.

**BASIC COMPONENTS OF AN IPM PROGRAMME**

### OBSERVATION

**Decision tools:**
- Crop monitoring
- Support decision taking systems
- Area-wide management

### PREVENTION

**Indirect Measures:**
- Location
- Crop rotation
- Cropping pattern
- Phylogenetic
- Crop husbandry and hygiene
- Fertilisation
- Irrigation
- Habitat management
- Trap crops
- Inter-cropping
- Harvesting and storage

### INTERVENTION

**Direct measures:**
- Mechanical and physical control
- Biological control
- Microbiological control
- Ecological control
- Selective chemical control

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Note for the trainer: Using the information contained in previous steps, present an IPM plan. Ask participating farmers to give their comments on the elaborated plan. Make them participate. End the activity making a summary.
STEP No. 5 –
INTEGRATED CROP MANAGEMENT AND SUSTAINABLE AGRICULTURE

The need to produce more food and fibre, applying sustainable practices has favoured the development of new management systems that contemplate all available resources for pest control. Modern farming trend is to put into practice integrated crop management or sustainable agriculture. This type of agriculture combines economy and ecology as equal and balanced components, using proved and traditional techniques together with innovative techniques.

Integrated crop management (ICM) is the most promising technique for the production of enough food and fibre. As a farming technique, it has several guiding principles: Place crops under local farming conditions; constant crop rotation; establishment of coverage crops all year round; use of pest resistant varieties; use exact fertiliser dose, according to crop requirements; weed control; use of biological controllers whenever possible; management of organic and inorganic waste; efficient use of energy in the farming system; conservation of biological diversity; rational use of plant protection products, etc.

Sustainable agriculture contemplates those farming systems that are economically feasible and help to meet world’s social need for enough and healthy food available but at the same time conserving natural resources and keeping the quality of the environment for future generations. In this sense, farmers should always make use of the new options of plant protection products available in the market, which have a lower impact on health, safety and environment.

At present, modern products, with specific effects on the metabolic system of plants and insects, which have reduced or no secondary effects for other biological organisms are frequently used.

Nowadays, through the application of integrated pest management, farming has access to a broad range of options that permit to improve treatment efficiency, to reduce the amount of products to be used and, consequently, the amount of residues on the crops.

Note for the trainer: Explain to the participant’s present farming trend. Use the illustrations shown on next page.
UNIT # 3

GENERALITIES ABOUT PLANT PROTECTION PRODUCTS

4.1 PLANT PROTECTION PRODUCTS: ADVANTAGES AND DISADVANTAGES

4.2 CLASSIFICATION OF PLANT PROTECTION
CHAPTER No. 3.1
PLANT PROTECTION PRODUCTS - ADVANTAGES AND DISADVANTAGES

REVIEW OF CHAPTER 3.1

Farmers will have the opportunity to know which products are developed by the plant protection industry for their sale and distribution. Likewise, they will learn the advantages and disadvantages derived from their use.

The titles of the main subjects are:
A. Plant protection products
B. Pesticide concept
C. Advantages and disadvantages

OBJECTIVES:

At the end of the activity the participant dealer will be able to:
- Identify plant protection products
- Mention the name of several products
- Know the pesticide concept
- Mention some advantages and disadvantages derived from their use

TIME REQUIRED:

15 minutes

STEP No. 1 – PRESENTATION: PLANT PROTECTION PRODUCTS

The demands of a growing world population for food and fibre require world agriculture to produce higher yields from cultivated land. Feeding future populations with today’s crop yields is not viable; it would require a drastic expansion of planted acreage. In many parts of the world additional land is unavailable. In others, an expansion of cropped area would be environmentally and socially unacceptable. To increase yields from existing land requires a good plant protection technique against losses before and after harvesting.

The challenge will be to do this without harming the environment and natural resources for future generations of farmers and consumers. IPM is a principle on which sustainable plant protection can be based.

A contribution from the plant protection industry is to develop products compatible with IPM, investigating products, including a decrease in dose; developing mixtures, reducing the drift and the lixiviation to subterranean waters, developing safer and more efficient formulations, making tests of seed treatments, improving containers quality and elimination practices.

Among developed and researched plant protection products we can find: Insecticides, fungicides, herbicides, rodenticides, etc.
More population means less farm land per person for food and fibre production.

Note for the trainer: Use pictures to illustrate this panorama. If possible bring samples of products in their original containers with a guarantee seal. Make a display. Request help from the industry.

STEP No. 2 – PRESENTATION: PESTICIDE CONCEPT

There are various ways to manage and control pests. Two of them are chemical and biological alternatives: using pesticides. A pesticide can be defined as any chemical or biological substance; biological agent or substance mixture destined to attack, destroy, control, prevent, diminish or repel the action of pest organisms that affect the health and well being of man, domestic animals and useful plants. The term includes substances destined to be used as plant growing regulators, defoliators, dehydrators, agents to reduce fruit density or agents to avoid fruits premature fall. Also substances applied to crops before or after harvest to protect the product against deterioration during the storage or transportation process.

STEP No. 3 – PRESENTATION: ADVANTAGES AND DISADVANTAGES DERIVED FROM THE USE OF PESTICIDES

In several regions of the world, most pests are responsible of transmitting diseases and of food loss and destruction. Losses of 20 – 30% of the harvests during production and over 20% during storage are not uncommon. Consequently, even though there are other alternatives to manage and control pests, many times the responsible use of pesticides is
necessary to obtain enough food that will provide us with an adequate and nutritious diet to keep healthy.

In farming, the use of pesticides presents various advantages:

- **Quick action:** Pesticides are useful when other control methods fail and an emergency arises. When a pest increases and exceeds the economic damage threshold, pesticides can act faster than other methods. Pesticides can solve the problem in a few hours or a few days.

- **Varied application:** Pesticides are found in several formulations. This means that they can be efficiently used in various situations. Their flexibility and adaptability constitute a great advantage.

- **Reduced cost.** As a general rule, pesticides are economic, particularly if their cost is compared with the cost of the crop that can be saved. But, it must be born in mind that application cost will be higher than the damage or harvest loss if pesticides are applied before reaching the economic damage threshold.

But the most important reason why this control alternative continuous being used is that in some cases pesticides constitute the only means to attack a pest and they also contribute to humans’ good health and well being, (preventing and curing diseases and providing abundant quality food).

However, it is convenient to remember that the use of pesticides can be dangerous for man and environment; therefore, it is necessary to know some disadvantages derived from their wrong management:

- **Pest resistance to pesticides.** By trying to find solutions to this problem, that is to find pesticides that can be used to control resistant pests, large amounts of pesticides have been introduced in world’s market, some of them highly toxic.

- **Human and animal toxicity.** With the introduction of more toxic pesticides, human intoxication by pesticides has become a health problem.

- **Persistence of certain pesticides:** The persistence of certain pesticides brings as a consequence food, water, and land and air contamination.

- **Container elimination; old or due pesticide stock:** The wrong use of pesticide containers and the wrong disposal of due products at stores constitutes another personal safety and environmental contamination problem.

**Note for the instructor:** Use illustrations to explain the problem to the participants. Ask the growers to expose some ideas, use the board to write them down. Enrich their points of view; clarify wrong ideas. End with a resume.

**CHAPTER NO. 3.2**
CLASSIFICATION OF PLANT PROTECTION PRODUCTS

CHAPTER REVIEW

Farmers will learn to classify plant protection products, according to their biological action, most common chemical groups in working site, mode of action, most common formulations, danger and legal aspects.

The main subjects are:

A. Classification of plant protection products, according to their biological action.
B. Classification of plant protection products, according to their chemical group.
C. Classification of plant protection products, according to their mode of action.
D. Classification of plant protection products, according to their action spectrum.
E. Classification of plant protection products, according to their formulation.
F. Classification of plant protection products, according to their danger.
G. Classification of plant protection products, according to legal aspects.

OBJECTIVES

At the end of the activity the participant will be able to classify the most commonly used plant protection products, according to the following criteria:

- Biological action
- Chemical group
- Mode of action
- Action spectrum
- Formulation
- Danger, and
- Legal aspects

TIME REQUIRED

60 minutes
STEP No. 1 – PRESENTATION:
CLASSIFICATION PER BIOLOGICAL ACTION

Depending on the organism subject to control, plant protection products are classified in: insecticides, acaricides, fungicides, bactericides, nematicides, rodenticides, ovicides, herbicides, etc. On the other hand there are insecticides that perform their biological action during certain insect developing stages, for example, eggs, (ovicides); larvae (larvicides); nymph (nymphicides) adults (adulticides).

RELATION OF PESTS AND PESTICIDES

In the left column there are the names of several pest organisms. Mark with an arrow the pesticide that relates with one of the objective organisms.

NEMATICIDE

ACARICIDE

INSECTICIDE

 FUNGICIDE

HERBICIDE

RODENTICIDE

MOLUSQUICIDE

Note for the instructor: Use illustrations and relate pesticides with objectives to be controlled. Evaluate participating farmers. Use attached test.
STEP No. 2 – PRESENTATION AND DEMONSTRATION:
PLANT PROTECTION PRODUCTS CHEMICAL GROUPS

There are various groups of chemical products. It is very important to know them from the agricultural point of view, since some of them cannot be mixed because they are not compatible with each other; besides, if they are known, a pesticide rotation programme can be implemented to manage resistance problems. It is also very important to know this for the worker’s safety, since depending on the chemical group to which the pesticide belongs, in case of intoxication, the appropriate first aid measures can be applied and the worker can be given the correct medical treatment. However, it is convenient to clarify that in the same chemical group there might be products for which it will be necessary to apply a very specific first aid and medical treatment; therefore, it is absolutely necessary to read both their label and pamphlet.

Insecticide chemical groups are: organochlorates (practically discontinued) organophosphates, carbamates, pyrethroids, chloronicotiniles, benzoilureas, dibenzofuranes, acridiones, tiosulfones, tiaodazines, oximas carbamicas, tioureas, ethalates, fenoxibenciles, benzamides, pyrediazinones, phenyl ether, pirroles, organofluorines, hydracines, tritianes, formamidines, etc.

Acaricide chemical groups are: organophosphates, carbamates, norpyrethroids, formamidines, organomethalics, imides, pyrethroids, benicles, tiaodazines, tetrazines, quinoxalines, dinitrofenoles, pirazoles, tiazolidines, etc.

The most common fungicide chemical groups are: Copper salts, sulphur, dithiocarbamates, ethylenbisdiocarbamates, nitrofeniles, triazoles, benzimidazoles, pirimidines, acilanilines, sulfamides, morfelines, fitalimides, phosphoric acids, conazoles, phosphates, diferenes, anilides, ureas, tiadizines, pyridazines, quinones, pyridisulfuros, benzamine, amtraquinones, oxazoles, gaunidines, tiaodizoles, pirroles, piperidines, imidazoles, dithiolanos, pyrazolines, isofaltalts, oxazolidines, quinocines, pyridines, methoxiacriskates, etc.

The most common herbicide chemical groups are: phenoxy acids, phosphonic acids, bypriridiles, triazines, oxidazoiles, triazoles, ureas, dinitroanilines, benzoicos, acetanilides, difenil ether, oximes, organophosphates, benzoofuraniles, benzotiaodizoles, pirazoles, benziationes, phosphoniles, uraciles, carbamates, sulphonurizes, pyrazinanones, pyridones, furanonases, imidazoles, falamates, quinoxalines, etc.

Note for the instructor: Ask participating farmers to give you the names of the products used in the field. Write the names and classify them by insecticides, fungicides, herbicides. Then, separate them according to their chemical group. Try to make everybody participate and to give you the largest amount of information possible.
STEP No. 3 – PRESENTATION AND DEMONSTRATION:
MODE AND SPECTRUM OF ACTION OF PLANT PROTECTION PRODUCTS

Insecticide Mode of action:
The insecticide penetrates the insect’s body in different ways, its mode of action must act according with the behaviour and feeding habits of the pest. This classification is based on the form which plant protection product act on the pest’s organism. In general terms and in the case of insecticides, they are classified as:

Contact insecticides: These are products that exercise toxicity once they get in contact with the objective organism; it can be by direct or residual contact.

Ingestion or digestive. These are products that act after the product has been ingested by the objective organism.

Asphyxiating: Penetration is in gaseous state through the respiratory system of the objective organism.

Penetrant (translaminars): These can reach up to certain depth inside the treated part, but cannot translocate or store in other organs located further away in enough quantity to make it effective.

Systemic: These products are absorbed by the plant’s treated part and are transported through the tissues —specially vascular tissues —in enough quantity to be effective at the action points (leaves and sprouts). They are used to control chewing and soaking insect pests.

Polyvalent: These are products that can act in more forms than the ones mentioned before.
Fungicides mode of action:

Fungicides must prevent fungus from penetrating the plant in order to avoid an infection, or execute control on the plant’s present infections. They are classified in:

**Preventative fungicides, protective fungicides and contact fungicides:** The majority of the most known fungicides have traditionally been preventative; this means that they are applied to prevent that the fungus infect the plant. Protective or preventative fungicides act by causing a toxic effect on the fungus spores or on their germinating tubes, thus avoiding that the fungus penetrate the plant’s tissue and cause an infection. Due to their type of action, it is very important that these fungicides be distributed homogeneously in all the leaves’ surface but especially on the reverse, because it is in this place where the fungus germinating tubes penetrate through the stomas. When fungicides are applied, the whole foliar surface must be thoroughly covered.
**Penetrating fungicides:** These are the fungicides that penetrate the foliar lamina, although they are not able to redistribute inside the plant.

**Systemic or curative fungicides:** These fungicides are able to penetrate the leaf and to be translocated through the vascular system. This permits certain control of present infections. The plant absorbs systemic fungicides and in most cases they are translocated from the penetration point to other tissues inside the plant. Systemic fungicides move from one part of the leaf to another; they never cross its central vein, but can move from the leaf’s base toward the leaf’s tip. Its vascular movement is usually upwards and very rarely downwards, reason why foliar treatments do not have an effect on the roots.

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**PLACES IN WHICH CONTACT AND SYSTEMIC FUNGICIDES ACT DURING A DISEASE CYCLE**
Note for the instructor: Use previous illustration and explain a disease cycle. Then indicate at what moment a contact or preventative fungicide acts as a systemic or curative fungicide.

In the case of herbicides, these can be:

**Foliar contact:** Contac herbicides act only on the plant’s exposed parts; therefore, spraying must be made thoroughly. When weeds growing among trees and bushes are sprayed, an impact nozzle must be used or apply low pressure to reduce the drift to a minimum. This is also important when the spraying is being done by a crew.

**Systemic of foliar translocation:** Herbicides of foliar translocation are absorbed through the leaves and translocated by the stem to the plant’s roots. They must be applied when weeds are vigorously growing. Due to their absorption and movement through the plant, their coverage must not be very complete as in the case of contact herbicides.

**Systemic, translocated by the root.** Most residual herbicides must be applied on a humid, finely cultivated soil. Some need to be incorporated to the soil by mechanical means, immediately after their application. Selectivity of residual herbicides depends on the crop’s tolerance regarding the herbicide, or that the crop has been sown deep enough to prevent any damage. When using a residual herbicide it must be taken in consideration whether crop rotation is being done. Some herbicides will remain active enough time to damage next crop. Atrazine should not be used in corn crops if next crop is sensible to atrazine, such as tobacco, vegetables, alfalfa or wheat.

Note for the instructor: He should explain each of the modes of action. Use illustrations. The following illustration can be used.

![HERBICIDE OF FOLIAR CONTACT](image-url)
Regarding their action spectrum, pesticides are classified as:

- Polytoxic or with broad spectrum
- Oligotoxic or with reduced spectrum, and
- Monotoxic or specific
STEP No. 4 – PRESENTATION AND DEMONSTRATION:
FORMULATIONS OF PLANT PROTECTION PRODUCTS

Most of the ingredients in plant protection products are organic compounds that many times are hard to dissolve or water insoluble. They belong to the most unlike chemical matters, have different physical properties, can be solid or liquid and have a consistence similar to wax. The active ingredients can only develop their biological action if they definitely arrive to the point where they should act in the organism objective. And the purpose of the formulation is to make sure that this happens. Formulation is the form in which an active ingredient is prepared, accompanied by coadyuvant matters, such as solvents, bearers or vehicles, emulsifiers, moisturisers, surfactants and dispersants. Usually, plant protection products can be purchased in two formulations: Liquid and solid.

Liquid formulations:
Emulsion concentrates (EC). These are solid or liquid active matters and organic solvents. Adding the proper emulsion, such solvents can be mixed with water. The original transparent liquid turns into a whitish and milky emulsion, whose drops measure approximately one micro. Emulsion concentrates are easily produced and managed. The necessary dose for a treatment can be easily measured and dosed with a graduated glass. The emulsion’s homogeneity should be restored by shaking and pumping it. The empty container can be simply cleaned with a washing object. Some emulsion concentrates also have their disadvantages because their solvents may be phytotoxic, they are inflammable and due to the damage they cause to the environment.

Note for the instructor: Show the participants how an emulsion can be formed. Use water, oil and transparent liquid soap. Shake continuously. An emulsion is a colloidal suspension consisting on microdrops of a liquid solvent. Each small drop acts as a lens and disperses the light; for this reason the mixture is opaque.

Water soluble concentrate (SL). Formulations of this nature consist on concentrate solutions made of active matters or their salts, with water base or solvent mixable with water. Therefore, it is essential that the active matter be soluble in water. The containers of SL formulations can be cleaned very easily.

Note for the instructor: Show the participants how a solution is formed. Use a soda and water. Let it rest and, together with the participants, compare this case against the previous case. Reach a conclusion.

Concentrated suspension (CS). This type of formulation is also called flowable formulation. They are stable suspensions made of water soluble active matters. The essential advantage of the CS is that they do not drop powder and do not contain any solvent, and therefore, the user is not exposed to contamination when preparing the spraying mixture. Besides, the concentrated suspensions can be easily measured and be
well dosed. As an inconvenience, it can be pointed out that CS formulation can decompose during storage and it can be troublesome to empty completely the containers.

**Microencapsulate; capsule suspension (CS).** These types of suspensions represent a different type of formulation, with slow liberation, characterised by the fact that, when they are applied, the active matter is slowly liberated. The main objectives of this formulation are: To reduce acute toxicity and, therefore, less risk to the user (more personal safety). To prolong the action period, in order to decrease the number of treatments (less environmental contamination). To lower toxicity and avoid loss of active matter due to evaporation.

**Solid products:**

**Wettable Powder (WP).**

These are solid active matters that are not soluble enough and, therefore, do not admit EC or SL formulations. They used to be launched in the market as wettable powder (WP). These formulations are manufactured by grinding the active matter, together with solid dispersing and moistening vehicles and reducing them to powder.

They are mixed with water for their application, mixing them in a container; this way a stable suspension is obtained. In view that the powder is so fine, the user may be exposed to contamination derived from powder emanations when the mixture is being prepared. Another inconvenient is that the powder has to be weighed if only part of it is taken out of the container.

- **Soluble Powders (SP):** The formulations of soluble powders, are dry formulations to be solved in water, do not require much agitation and make a real solution. The quantity of the active ingredient per formulated product is high.

- **Granulates (GR):** The granulated formulation is obtained by applying an active ingredient in a liquid stage to the granules or big particles. The granules can absorb or be covered by the liquid active ingredient. In either cases, the granule dries but the active ingredient that is in or over it accomplishes its toxic action.

**Water dispersible granules (WG)**

This is a safer formulation for the user; it was created specially to replace wettable powders. In comparison with these, water dispersible granules need a larger proportion of dispersible granules so that when they are mixed with water the active matter disperses spontaneously. Their main advantage is that no powder comes off when the mixture is being prepared. Water dispersible granules are flowable and their apparent density is constant, which makes it easy to measure them with a graduated glass. On the
other hand, the container can be emptied without leaving any residues inside. Their stability during storage is similar to EC and WP formulations.

Note for the instructor: Use powder, grains, etc., to simulate solid formulations. Show the participants each sample. Comment the results with them. Explain and clarify doubts. Make a resume.

STEP No. 5 – PRESENTATION: CLASSIFICATION OF PLANT PROTECTION PRODUCTS, ACCORDING TO THEIR RISK

Plant protection products are useful to manage and control pest organisms. However, they can also cause intoxication to persons who handle them. In order to determine whether they are harmful to humans, toxicological studies are being performed in other mammals, such as rats, mice, rabbits and dogs. The results of these tests help to predict their risk to humans, establish safety measures during handling and classify products according to their risk. In the following chart a classification of plant protection products is shown, according to their toxicity.

CLASSIFICATION OF PLANT PROTECTION PRODUCTS ACCORDING TO WHO (World Health Organisation).

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>PICTOGRAMME</th>
<th>WARNING</th>
<th>COLOR</th>
<th>ORALLY SOLID</th>
<th>ORALLY LIQUID</th>
<th>THROUGH SKIN SOLID</th>
<th>THROUGH SKIN LIQUID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a/1 Extremely</td>
<td>☠️</td>
<td>Very toxic</td>
<td>Red</td>
<td>&lt; 20</td>
<td>&lt; 10</td>
<td>&lt; 40</td>
<td></td>
</tr>
<tr>
<td>Ib/2 Highly dangerous</td>
<td>☠️</td>
<td>Toxic</td>
<td>Red</td>
<td>- 50</td>
<td>&gt;20 - 200</td>
<td>&gt;10 -100</td>
<td>&gt;40 - 400</td>
</tr>
<tr>
<td>II/3 Moderately dangerous</td>
<td>⚠️</td>
<td>Dangerous</td>
<td>Yellow</td>
<td>- 500</td>
<td>&gt;200 - 2000</td>
<td>&gt;100 -1000</td>
<td>&gt;400 -4000</td>
</tr>
<tr>
<td>III/4 Slightly dangerous</td>
<td>⚠️</td>
<td>Careful</td>
<td>Blue</td>
<td>- 2000</td>
<td>&gt;2000 - 3000</td>
<td>&gt;1000</td>
<td>&gt;4000</td>
</tr>
<tr>
<td>IV/5</td>
<td></td>
<td>Precaution</td>
<td>Green</td>
<td>Over 3000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note for the instructor: Use strips with the colours that represent the danger categories (toxicological categories). Ask the farmers what is their meaning. Make sure they associate the colours with the corresponding danger. That must be your main objective.
STEP No. 6 – PRESENTATION:
LEGAL ASPECTS OF PLANT PROTECTION PRODUCTS

To be able to use a plant protection product in a determined country, this must have the approval from a government organism or organisms in charge of regulating its manufacture, commercialisation and use. Taking this in consideration, the products are classified in registered products, non-registered products, restricted products, and prohibited products. For export farming it is very import to know the norms and criteria established by local authorities from importing countries. For example:

- EPA (Environmental Protection Agency from U.S.A.)
- Codex Alimentarius from European Economic Community.

Note for the instructor: Prepare and take to the classroom a list of prohibited or severely limited products, according to local legislation. Also, prepare a list of plant protection products authorised by EPA and Codex Alimentarius. End the activity with a review of the chapter.
UNIT # 4

LABEL AND PAMPHLET OF PLANT PROTECTION PRODUCTS
UNIT #4

REVIEW OF THE UNIT

The participant farmers should understand the importance that the label and pamphlet as legal documents have, and to solve all doubts that they have of how to use and manage in a safe and responsible manner the plant protection products. That is the reason of the need of reading both documents before buying a product, applying it, to storage and transport, when the empty containers should be eliminated and in case of an accident.

As follows they are able to identify different kinds of labels and pamphlets, recognize the different parts of a label and pamphlet, and know about the information that both have.

The titles of the main subjects are:

A. Definitions: What is a label?, What is a pamphlet?
B. The importance of the label and pamphlet
C. Kinds of labels
D. Main parts of a label and pamphlet
E. Use of the label and pamphlet

OBJECTIVES

At the end of the unit the farmer will be capable of:

- Distinguish between a label and a pamphlet;
- Recognize how the label and pamphlet complement each other, giving all the necessary information of the safe and responsible management of a plant protection product;
- Identify in the label and pamphlet where to find the needed information;
- Identify the toxicity of a plant protection product according to the colour of the label and the advising phrases;
- Make a correct use of the label and pamphlet.

TIME REQUIRED

60 minutes
STEP No. 1 – PRESENTATION AND DEMONSTRATION
What is a label? and What is a pamphlet?

The label from plant protection products is defined as any written, printed, or engraved material, adhered to the container, package or exterior wrapping for retail sale or distribution.

The pamphlet is an additional informative sheet that must be included with the product when the purchase takes place. That document contains very important agricultural information to manage and use the product in a safe and responsible way.

Recommendations for the Instructor: He should supply himself with several label and pamphlet samples of plant protection products being sold or distributed in the geographical area in which the growers being trained are working. He should expose the material, comment and clarify any doubts.

STEP No. 2 – PRESENTATION OF THE IMPORTANCE OF LABEL AND PAMPHLET

The label and pamphlet are the legal documents that should be handed to the buyer in most countries. It is required that these documents be written in the country’s official language and, in addition, they should show all the information and instructions for the safe and responsible management of plant protection products; therefore, the information must be written in a language that can be understood by the user.

Following is some of the information that should appear on the label: Name of the formulator, commercial name of the product, concentration, formulation type, biological action, name of active ingredient, use precautions and warnings (with their respective pictogram’s), intoxication signs and symptoms, first aid, antidotes, some environmental issues (also with pictogram’s) and the colour band that identifies its danger, with the corresponding warning phrases.

The pamphlet, besides containing most of the information that appears on the label, it should mention agricultural aspects, such as, action mode, application equipment, how to prepare the mixture, recommendations of use against pest organisms, recommended dose, application intervals, waiting time between last application and crop, waiting period to return to treated area, phytotoxicity, compatibility, etc.

Recommendations for the Instructor: Using the board, group the information that appears on the label and compare it with the information on the pamphlet. Have the participants discuss the subject and come to their own conclusions.
STEP No. 3 – DEMONSTRATION:
TYPES OF LABELS AND PAMPHLETS; THEIR PARTS

There are three types of labels: With one body (one face); with two bodies (two faces) and three bodies (three faces). These are used for obligatory labelling of products formulated for agricultural use, according to their size. One-body labels are used on small containers and the three-body labels in larger containers. Pamphlets constitute an informative document that must be handed to the buyer when he buys the product, regardless of size. All pamphlets contain the same information.

Recommendations for the Instructor: Organise some working groups and give them labels and pamphlets so the participants can find out the differences between the two. Ask them to study carefully the labels and pamphlets and answer the questions that you have prepared on a sheet of paper. Some examples of questions can be the following: What is that product for? What products control pest “X”. Which is the most dangerous product? Which is the least dangerous? Use your creativity to make other questions. Correct errors and clarify doubts.

STEP No. 4 – SUMMARY: USE OF LABEL AND PAMPHLET

The best way to use labels and pamphlets is to read them to solve any doubts about the correct and safe manner to use a plant protection product. It is important to recognise that there are at least five situations on which it is necessary to read the label and pamphlet. These are:

- Before buying the product. Selecting the product is easier if the label and pamphlet are read thoroughly before purchasing. Both documents help to identify the appropriate product to treat the problem that the crop presents. Before buying or using a product, the user should recognize the risks or problems that could emerge.
- Before preparing the dosage and the mixture or applying a product. The label and pamphlet have the instructions and warnings about the use of the product; for that reason, it is always necessary to read both documents before preparing the dosage and the mixture or applying a product. This will give assurance that the product is being used correctly.
- Before storing and transporting the product. The label as well as the pamphlet indicates the proper procedures for storage and transportation.
- Before eliminating empty containers. These documents contain the procedures for a correct elimination of empty containers, including triple rinse.
- At the time of an accident or an emergency caused by the incorrect use of a product.

Always remember how important and useful it is to read both the label and the pamphlet!

The instructor should end the unit making a recapitulation. He should evaluate the level of learning of the participants and clarify their doubts.
CONSULTE AL PROFESIONAL EN CIENCIAS AGRICOLAS

Manufacturer's Logo
Product commercial name

COMPOSICION QUIMICA: P/P
Azufre .......................... 80.00%
Ingredientes Inertes ................ 20.00%
TOTAL .................................... 100.00%

Contiene 800 gramos de ingrediente activo por kilogramo de producto comercial.
Contenido neto: 227 Gramos

PRECAUCION
EN CASO DE INTOXICACION LLEVE AL PACIENTE AL ...
Y DELE ESTA ETIQUETA O EL PANFLETO

ALTO! LEA EL PANFLETO ANTES DE USAR EL PRODUCTO
Y CONSULTE AL PROFESIONAL EN CIENCIAS AGRICOLAS

Manufacturer's Logo
Product commercial name

COMPOSICION QUIMICA: P/P
Ingredientes Inertes ................ 20.00%
TOTAL .................................... 100.00%

Contenido neto: 227 Gramos

Manufacturer's Logo
Product commercial name

COMPOSICION QUIMICA: P/P
Ingredientes Inertes ................ 20.00%
TOTAL .................................... 100.00%

Contenido neto: 227 Gramos

LABELS IN ENGLISH SHOULD BE INSERTED ON THIS PAGE

ONE-BODY LABELS
TWO-BODY LABELS

LABELS IN ENGLISH SHOULD BE INSERTED ON
LABELS IN ENGLISH SHOULD BE INSERTED ON THIS PAGE

THREE-BODY LABELS
PICTOGRAMMES
**CUIDADO**

**ANTIDOTO:** Sulfato de Atropina

**SO AGRONÓMICO:**

**ODO DE ACCION:** aracólex 5,95 RB, actúa por contacto e gestión.

**QUIPO DE APLICACIÓN:** aracólex 5,95 RB, viene listo para ser aplicado. La aplicación se hace mediante aplicadores manuales, directamente sobre los surcos del cultivo. Aplíquese uniformemente sobre el terreno, al voleo o en pequeños monolititros de 60 cm. entre sí. Se recomienda aplicarlo de preferencia por la mañana y no antes de una lluvia fuerte o riego pues sería lavado y/o diseminado el efecto.

**DOSIS RECOMENDADAS**

A partir de 6,4 a 10 kilogramos por hectárea, (de 4,5 a 7 kilogramos por manzana), de Caracolox 5,95 RB.

**RECOMENDACIONES DE USO**

<table>
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<tr>
<th>CULTIVOS</th>
<th>PLAGAS</th>
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</thead>
<tbody>
<tr>
<td>Guayabo</td>
<td>Babosas de hoja</td>
</tr>
<tr>
<td>Plátano</td>
<td>Babosas de tallo</td>
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<tr>
<td>Cacao</td>
<td>Babosas de tronco</td>
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<td>Café</td>
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</tr>
<tr>
<td>Frutales</td>
<td>Babosas de tallo</td>
</tr>
</tbody>
</table>

**INTERVALO DE APLICACIÓN**

De 8 a 15 días.

**INTERVALO ENTRE LA ÚLTIMA APLICACIÓN Y LA COSECHA**

10 días.

**INTERVALO DE REINGRESO AL ÁREA TRATADA**

Sin restricción.

**FITOTOXICIDAD:** Caracolox 5,95 RB no es fitotóxico a las dosis recomendadas.

**COMPATIBILIDAD:** Caracolox 5,95 RB, se aplica solo.

**PRECAUCIONES Y ADVERTENCIAS DE USO:**

Almacenamiento y transporte: Conserve y transporte el Caracolox 5,95 RB en su empaque original, etiquetado y cerrado herméticamente. No transportarlo ni almacenarlo junto con alimentos, herbicidas, forrajes y medicamentos. Almacénelo en un lugar fresco y seco. Manejese con cuidado para evitar derrames. Si ello ocurre, recójalo con una pala y aplique a lo largo del cultivo según las recomendaciones del producto.

**NO ALMACENAR ESTE PRODUCTO EN CASAS DE HABITACIÓN**

**MANTENGASE FUERA DEL ALCANCE DE LOS NIÑOS**

**SINTOMAS DE INTOXICACIÓN:**

Dolor de cabeza, mareos, temblores musculares, cílicos, vómitos, diarreas, sudoración, tos con flemas, en casos severos puede ocurrir edema pulmonar y convulsiones.

**PRIMEROS AUXILIOS:**

**POR INGESTIÓN:**

Provacar el vómito, estimulando la parte posterior de la garganta con la punta del dedo índice. Repita el estímulo hasta que el vómito fluya claro.

**DO A LOS PERIODOS DE CARENCE Y LIMITES DE TOLERANCIA EN LOS CULTIVOS DE EXPORTACION RECOMENDADOS EN ESTE PANFLETO Y CON APEGO A LAS NORMAS LEGALES DEL PAIS PRODUCTOR Y DEL PAIS IMPORTADOR, ES RESPON- SABILIDAD EXCLUSIVA DEL USUARIO EN CASO DE DUDA, CONSULTE LAS PUBLICACIONES RESPECTIVAS O AL TECNI- CO EN LA MATÉRIA.**

**FORMULADO Y DISTRIBUIDO POR:**

Bayer S. A., Km. 20.5 Ruta al Pacífico 633-0496, 633-0451, 633-0452 Guatemala, Guatemala.

**IMPORTADO Y DISTRIBUIDO POR:**

Bayer S. A.
Bvd. Bayer Citédad Merid. Apartado 5193 1000 San José, Costa Rica
Tel: 506-2216166

**PAÍS**

**NÚMERO DE REGISTRO**

**REAR BODY**

**CENTROS DE INFORMACION TOXICOLÓGICA**

<table>
<thead>
<tr>
<th>PAÍS</th>
<th>NITRIFICOS</th>
<th>TELÉFONOS</th>
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<tbody>
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<td>Guayabo 307</td>
<td>San Salvador</td>
</tr>
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</table>

**AVISO DE GARANTÍA:**

Garantizamos que la composición y concentración de este producto se indicado en el etiqueta. Sus instrucciones de uso se basan en rigurosos y extensos ensayos en el mundo. Sin embargo, como su aplicación y manejo están fuera de nuestro control, no damos ninguna garantía expresa o implícita sobre los resultados al usuario.

**EL USO DE ESTE PRODUCTO, DE ACUER- DO A LOS PERIODOS DE CARENCE Y LIMITES DE TOLERANCIA EN LOS CULTIVOS DE EXPORTACION RECOMENDADOS EN ESTE PANFLETO Y CON APEGO A LAS NORMAS LEGALES DEL PAIS PRODUCTOR Y DEL PAIS IMPORTADOR, ES RESPONSABILIDAD EXCLUSIVA DEL USUARIO EN CASO DE DUDA, CONSULTE LAS PUBLICACIONES RESPECTIVAS O AL TECNICO EN LA MATÉRIA.**

**REAR BODY**

**FRONT BODY**

**INTERVALO DE APLICACIÓN**

De 8 a 15 días.

**INTERVALO ENTRE LA ÚLTIMA APLICACIÓN Y LA COSECHA**

10 días.

**INTERVALO DE REINGRESO AL ÁREA TRATADA**

Sin restricción.

**NO COMER, FUMAR O BEBER DURANTE EL MANEJO Y APLICACIÓN DE ESTE PRODUCTO**

**BÁNESE DESPUÉS DE TRABAJAR Y PONGASE ROPA LIMPIA**

**SINTOMAS DE INTOXICACIÓN:**

Dolor de cabeza, mareos, temblores musculares, cílicos, vómitos, diarreas, sudoración, tos con flemas, en casos severos puede ocurrir edema pulmonar y convulsiones.

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**NÚMERO DE REGISTRO**

**REAR BODY**

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**EL USO DE ESTE PRODUCTO, DE ACUER- DO A LOS PERIODOS DE CARENCE Y LIMITES DE TOLERANCIA EN LOS CULTIVOS DE EXPORTACION RECOMENDADOS EN ESTE PANFLETO Y CON APEGO A LAS NORMAS LEGALES DEL PAIS PRODUCTOR Y DEL PAIS IMPORTADOR, ES RESPONSABILIDAD EXCLUSIVA DEL USUARIO EN CASO DE DUDA, CONSULTE LAS PUBLICACIONES RESPECTIVAS O AL TECNICO EN LA MATÉRIA.**

**FORMULADO Y DISTRIBUIDO POR:**

Bayer S. A., Km. 20.5 Ruta al Pacífico 633-0496, 633-0451, 633-0452 Guatemala, Guatemala.

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Bayer S. A.
Bvd. Bayer Citédad Merid. Apartado 5193 1000 San José, Costa Rica
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**PAÍS**

**NÚMERO DE REGISTRO**

**REAR BODY**

**CENTROS DE INFORMACION TOXICOLÓGICA**

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<td>GUATEMALA</td>
<td>Centro de Información Toxicológica 223-2730</td>
<td>Calle 6-47 Zona 1, Guatemala, Ciudad 267-080 FAX</td>
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HOJAS ANCHAS:

Amaranthus spp  
Tithonia diversifolia  
Bleco  
Verdolaga

GUATEMALA, BELICE, EL SALVADOR, HONDURAS, NICARAGUA, COSTA RICA Y PANAMA

CULTIVOS  
SILVO TRAPERO  
SILVO MÉXICO  
SILVO PANAMÁ

DOIS LTROS POR HECTÁREA

AGRODIN
('Geoglossum trntrale')
MAÍZ
ARROZ
ICHA
Soyá
(Cajanus edulis)
FRÍO
(Phaseolus vulgaris)
BUCO
(Sorghum vulgare)
CEBOLL
(Capsicum annuum)
AJE
(Allium cepa)
PAPA
(Solanum tuberosum)
CAÑA DE AZÚCAR
(Saccharum officinarum)
QILOCHAZO
('Triticum aestivum')

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ALGODON: Apliquése en presiembra incorporado, con doble pase cruzado de rastra de 6 a 8 cm. de profundidad o proemergente inmediatamente después de la siembra, máximo 24 horas después. Si el suelo está húmedo o se esperan lluvias. No realizar aplicaciones postergenerantes ya que pueden ser muy fitotóxicas al cultivo.

MAÍZ: Aplique proemergente, solo o mezcla con atrazina (1 kg /ha), en postemergencia total al cultivo antes de que enverguen las raíces de arroz. El maíz debe sembrarse a una profundidad de 4 cm.

ARROZ: Proemergente, aplique inmediatamente después de siembra. Debidamente al momento de la aplicación, es indispensable tapar el semillero antes de la aplicación. Si no se aplique antes de la siembra, el suelo debe estar bien preparado y desgranado sin charcos o depósitos de agua. Aplique cuando se esperan lluvias o se va a irgar dentro de los 7 días siguientes a la aplicación. En arroz de riego es recomendable esperar un período no menor de 48 horas entre la aplicación y el establecimiento del siguiente riego. En postemergencia temprana, si se adiciona al Application de 2.5 a 3.8 kg /ha, cuando las malezas tienen 2 a 3 hojas. Es conveniente el uso del opto compactador de suelo antes de la aplicación, al finalizar la uniformización de la superficie del mismo y la germinación de la maleza. Para el control de arroces indelebles en arroz de riego, prepare y nivele el suelo, realice un riego de germinación (3 días), drene el suelo y aplique 4 litros de PROWLF 50 EC, después de tiempos de siembra de 12 días. Drene el campo y continúe con los mismos (mantégalos así de 7 a 14 días). Aplique gífnasato (3 hfa). Siempre el arroz comercial 2 a 3 días después de aplicar gífnasato. Use semilla pregerminada, tan pronto como el desarrollo del arroz lo permita, establezca la lámina de agua permanente. En este tratamiento se debe esperar un período de 24 días después de la aplicación para poder sembrar.

SOYA Y FRIJOL: Como proemergente aplicar inmediatamente después de la siembra (máximo 24 horas después) si el suelo está húmedo o se esperan lluvias. En presiembra incorporada aplique antes de la misma día de siembra, a una profundidad de 6 a 8 cm mediante doble pase cruzado de rastra o bien otro implemento que mezcle bien el terreno con el suelo.

SORGO: Aplique en mezcla con atrazina (800 -1000 g / ha) cuando el sorgo ha nacido y tiene de 5 a 4 hojas, Aplicaciones antes de la emergencia del sorgo o cuando éste está emergiendo son fitotóxicas, por tanto no deben hacerse. Mayor control de malezas será obtenido cuando las malezas tengan 2 hojas o menos al momento de la aplicación.

CÉBOLLA: Aplique 5 a 8 días después del transplante.

CARA DE AZÚCAR: En preemergencia absoluto a distancia de 2 a 3 litros por hectárea. En postemergencia se puede usar en mezcla con Terbutrina, Amtarina y Dualon o 2.4-D. En caña soca, el suelo debe estar libre de restos para que el herbicida pueda llegar al suelo. Si hay interferencia se recomienda una labor de cultivo mecánico para exponer el suelo al tratamiento con herbicida.

TABACO: PROWLF 50 EC es el producto en forma de comprimido antes de realizar el transplante.

AJO: Aplique proemergente después de la siembra y antes de la emergencia de las malezas. Para todos los cultivos es necesario una buena preparación del terreno.

USO AGRONOMICO

MODO DE ACCION: PROWLF 50 EC, herbicida selectivo absorbido por raíces y foliáceo translocado vía xilema y fórmica. Inhibe tanto la división como la elongación celular en meristemas del tallo y la raíz de las malezas susceptibles.

EQUIPO DE APLICACIÓN: PROWLF 50 EC, puede ser aplicado con equipo manual, terrestre o aéreo. Calibre bien el equipo antes de aplicar el producto. En aplicaciones aéreas el volumen de caldo no debe ser menor de 50 litros por hectárea, en aplicaciones terrestres use un mínimo de 200 litros por hectárea. Lave el equipo después de cada jornada de trabajo. Utilice boquillas de abanico.

FORMA DE PREPARACIÓN DE LA MEZCLA: Llene el tanque hasta la mitad con agua, vierta la cantidad recomendada de PROWLF 50 EC, termine de llenar el tanque mientras agita. Si se va a utilizar una suspensión líquida de otro producto haga una premescla de proporción 1 a 1 con agua y agregue esta premescla al tanque con agua (600 a 200 partes) agite hasta obtener una suspensión total, agregue PROWLF 50 EC al tanque mientras agita y termine de llenarlo del tanque. Si la mezcla va a ser con un polvo mejante, prepare una premescla 1 a 2 con agua, añada ésta al tanque de agua (600 a 200 partes), agite para lograr una buena suspensión, agregue PROWLF 50 EC, siga aplicando mientras termina de llenar el tanque. Se recomienda que PROWLF 50 EC, sea el último compuesto que se agrega al tanque.

RECOMENDACIONES DE USO: PROWLF 50 EC es un herbicida que combate las siguientes malezas:

| GRAMÍNEAS: |  
| --- | --- | --- |
| Cynodon dactylon | Abrañajo |  
| Cynodon spp. (de semilla) | Gramajo |  
| Digitaria horizontalis | Solis |  
| Digitaria sanguinalis | Alondra |  
| Echinochloa crus-galli | Barba de índio, Maiz de pelo |  
| Echinochloa crus-galli | Pata morcilla, cuchilla de agua |  
| Echinochloa crus-galli | Pata de gallo |  
| Echinochloa crus-galli | Sorgo |  
| Echinochloa crus-galli | Mazapitillo, Zacate manchado |  
| Echinochloa crus-galli | Zacate dulce, Zacate hondureño |  
| Echinochloa crus-galli | Palillo, plumilla, Coto de Bravo |  
| Echinochloa crus-galli | Pasto guineo |  
| Echinochloa crus-galli | Combrador, Zacate indio |  
| Echinochloa crus-galli | Coto de zorro |  
| Echinochloa crus-galli | Zacate Johnnys |  

LABELS IN ENGLISH SHOULD BE INSERTED ON THIS PAGE

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UNIT # 5

PLANT PROTECTION PRODUCTS RISKS FOR HUMANS AND ENVIRONMENT

5.1 RISKS FOR HUMANS
5.2 RISKS FOR THE ENVIRONMENT
UNIT # 5.1 RISKS FOR HUMANS

UNIT REVIEW

The participants should understand that when one is constantly working with plant protection products, it is necessary not to forget and to follow the warning and precaution measures that appear in the label and the pamphlet; on the contrary, accidents may occur.

For this reason, it is essential to know, the danger that involves the use and management of plant protection products; the way how these can enter to the human body, the different absorption grades in the skin; the signs and symptoms of an intoxication associated with the main chemical groups someone works with; the types of intoxication that may occur (acute, retarded and chronic), and the First Aid that can be given in the case an intoxication occurs. These knowledge would allow preventing and avoiding accidents that could have fatal consequences.

The main titles of the subjects in this workshop:

A. Risks or associated dangers to plant protection products.
B. The media lethal dosage (LD50).
C. Ways through which the plant protection products enter to the human body and absorption grades in the skin.
D. Signs and symptoms of intoxication by the more common chemical groups.
E. Types of intoxication: Acute, retarded and chronic.
F. First Aid in case of intoxication.

OBJECTIVES

At the end of the activity, the participants would be capable to:

- Recognize the dangerous categories that identify the different plant protection products.
- Identify and recognize the risks to which they are exposed when they use plant protection products;
- Recognize the routes through which the plant protection products enter to human body;
- Understand the different absorption grades of the skin when this is exposed to plant protection products.
- Recognize the different signs and symptoms of an intoxication provoked by plant protection products; and how to provide First Aid when an intoxication occurs.

REQUIRED TIME

60 Minutes
STEP # 1 PRESENTATION AND DISCUSSION: HUMAN RISKS ASSOCIATED TO PLANT PROTECTION PRODUCTS.

The plant protection products are useful for the control of pest organisms, but used in an inappropriate way causes accidental and occupational intoxications, besides of the intoxications and death for intentional ingestion with suicide purpose.

The previous situation proves that the plant protection products used in an irresponsible manner may be dangerous, the way to identify the toxicity of the plant protection products, consist in identifying the colour band in the labels, thus the red band means extremely or highly dangerous; the yellow, moderately dangerous; the blue, lightly dangerous and the green of very but very low danger. Also the pictogram’s and warning phrases in the labels and the pamphlets.

For the instructor: Organize a discussion about intoxication experiences with plant protection products. Ask any of the participants if any of them has been intoxicated with these products, or if they know someone that has suffered this type of experience. Motivate them to talk and discuss their experiences. During the discussion, determine if the people involved knew that it was an intoxication, or if they recognized the signs and symptoms and did not know how to act.

STEP # 2 PRESENTATION: LD50

All plant protection products represent a risk or danger of intoxication or death, but some of them are more dangerous than others, to determine the endanger (toxicity) of these products, scientists achieve experiments with animals such as: rats, mice, rabbits, guinea pigs, dogs and hens. In these experiments the scientists determine the quantity of product that is necessary to kill half (50%) of the treated animals. This quantity is called the media lethal dosage and is used to assign the danger band to the plant protection products. It is important to know, that when less the dosage is, the product endanger is higher.

For the instructor: accomplish a summary getting as a result, the following conclusions:

- Incorrectly use of plant protection products may cause intoxications and possibly death.

- The LD50, permits to classify the plant protection products from high to low danger.
WAYS TO DETERMINE THE LD50

Oral

Dermal

Inhaled
<table>
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<tr>
<th>DANGER</th>
<th>PHASE OF ADVISE</th>
<th>READ THE LABEL</th>
<th>EQUIPMENT REVIEW</th>
<th>Personal Hygiene</th>
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<td>PRECAUTION</td>
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Independently of the danger and toxicity of a plant protection product, the prevention practices; reading the label and the pamphlet, reviewing the good state of the application equipment (backpack sprayer, thus the personal hygiene measures, as washing the hands and the face before eating, drink or smoking, to shower after each application activity and put on clean clothing, permits to minimize that intoxication risks may occur.
The red arrow indicates that in the measure that increases the danger of a plant protection product, also its toxicity increases; nevertheless, using the clothing and personal protection equipment recommended in the pictogram, the risks of suffering an intoxication can be minimized (yellow arrow). It is convenient to insist that a product of very low toxicity badly managed may provoke intoxications, and to the inverse one of a very high toxicity correctly manipulated can avoid them. In some cases, according to the product the type of mask recommended may vary, reason why it is very important to read the label and the pamphlet.
STEP # 3 PRESENTATION AND DEMOstration: ROUTES THROUGH WHICH THE PLant PROTECTION PRODUCTS ENTER TO OUR BODY ABSORPTION GRADES BY THE SKIN.

There are four ways for a plant protection product enter to the human body: By the mouth (orally); by the nose and the mouth (inhalation); and through the skin (dermal) and by the eyes. The entrance by the mouth, is the less probable route, but it can be particularly dangerous; nevertheless, the precautions to avoid it are simple:

- Neither eat, nor drink, do not smoke with the hands contaminated by these products.
- Do not store plant protection products in bottles of drinkable products or food containers.
- Do not transport or store the products together with the food, to avoid contamination.
- Keep away the rodenticide baits and the treated seeds from the food, to avoid accidental consumption.

The inhalation could be dangerous, when very volatile products are used in closed environments or because the application method produces liquid or solid particles, quite fine can be inhaled. The use of respiratory masks and to accomplish the applications in appropriate hours is precautions that must be considered.

The most probable contamination is through the exposed skin. It can occur not only by the effect of a spilled or splash of a concentrate or a mixture, but also using contaminated clothing, the use of defective equipment or by continuous exposition to the pulverization. These products pass rapidly from the clothing to the skin and can enter the organism inclusive, through healthy skin and without wounds. The eyes, mouth, tongue and the genital region are zones particularly vulnerable. During hot weather, special measures should be taken due that the sweat increases the absorption capacity by the skin.

For the instructor: Use illustrated sheets where the penetration routes of plant protection products are signed, and the different absorption grades by the skin. Help yourself with the enclosed sheets.
BODY ABSORPTION ROUTES

- Eyes
- Nose
- Mouth

SKIN
SKIN ABSORPTION GRADES

35% Skull
40% Forehead
50% Ear conduit
20% Abdomen
8% Forearm
10% Palm
99% Scrotum
15% Foot
STEP # 4 PRESENTATION: SIGNS AND SYMPTOMS OF INTOXICATION.

When an intoxication occurs, there are many indications that allow recognizing it, those indications, are known as symptoms and signs. The symptoms are sensations that only the intoxicated person can feel, for example: headache, anxiety, blurry vision, etc. The signs are manifestations that occur in the patient but can be observed by a second or more persons, as for example: sweating, corporal tremors, vomits, etc. The symptoms and signs of a light intoxication include: headache, fatigue, dizziness, blurry vision, sweating, nausea, vomits, abdominal cramps, salivate and contractions (dwarf) of the pupils. A moderately serious intoxication, besides the previous symptoms, can produce indisposition and chest pressure, the pupil’s contraction, low cardiac rhythm, muscular tremors, confusion, lack of muscular coordination, difficulty to speak and Psychosis (strange and maniac behaviour). The mortal intoxication can have many manifestations that include faecal and urinary incontinence, heart irregularities and deteriorated respiratory function.

For the instructor: present a story about an intoxication experience that allows distinguishing symptoms of signs. Ask the participants to distinguish these signs and symptoms. Clear doubts. Present the enclosed material.

An 18 year old worker asked for medical attention to the health by nausea, dizziness, salivation, blurry vision, respiratory difficulty, weakness and uneasiness for two hours of duration. He informed that he started the plant protection products application at six O’clock in the morning, at seven drank water from a water bottle, he ate a pair of tortillas with beans. An hour later he began with discomfort, reason why he decided to suspend the application and consult a health .

Distinguish between the signs and symptoms.
SLIGHT SIGNS AND SYMPTOMS

tired  headache  dizziness  sweaty

blurry vision  vomiting  cramps  stomachache

MODERATE SIGNS AND SYMPTOMS
DANGEROUS SIGNS AND SYMPTOMS

difficulty to breathe

small pupils

unconscious

dripping nose and slobbering
STEP # 5 PRESENTATION: TYPES OF INTOXICATION.

The provoked intoxications by plant protection products are of three types: acute, retarded and chronic. The acute intoxications, are of short term. A person can intoxicate entering in contact once or many times in less than 24 hours with the plant protection products. The symptoms and signs of intoxication develop rapidly. The retarded occur by frequent expositions, repeated to the plant protection products during periods of many days or weeks. The symptoms and signs appear in a light intermittent manner or after months of expositions. The chronic intoxications that show in a long term due to the plant protection products accumulation in certain tissues and body organs, until long time later, inclusive years the intoxication symptoms appear. All persons that use plant protection products must recognize which are the symptoms and signs of intoxication by chemical groups with which they work, reason why here are described:

Intoxications with organochloride: The first symptoms and signs are: General pain, headache, irritability, dizzy, nausea, vomiting. Later the intoxicated person might present involuntary muscle contractions, tremors, respiratory difficulty, and convulsions and enter in a state of comma.

Intoxications with organophosphorus and carbamates. At the beginning the following effects are observed: headache, dizzy, fatigue or tiredness, blurry vision, excessive sweating, abundant saliva, tearing, stomach ache, diarrhoea, nausea and vomiting. The subsequent steps are characterized because the patient presents weakness, incapacity to walk, chest pain, contractions and muscle spasms, contracted pupils that do no react to the light. The final step comprehends the following characteristics: Loss of reflections, unconsciousness, breathing difficulty, involuntary urinate and defecates and death comes if medical treatment is not administered.

Intoxications with pyretrines and pyrethroids. The first symptoms that the intoxicated person shows are: tingling in the eyelids and the lips, conjunctive and mucous irritation, sneezing. Afterwards he presents intense itching, skin stains secretion and nasal obstruction, excitation and convulsions.

Intoxications with bypiridiles. In the intoxicated person it might produce skin irritation, irritation of the conjunctives, general discomfort, weakness, sores and burns in the mouth, abdominal pain, respiratory failing, and thirst, bleeding nose, lung, kidneys and liver damage.

Intoxications with herbicides of the phenoxi group. The acute intoxications with herbicides of the phenoxi group at the beginning provoke loss of appetite, irritation of the exposed skin, dizziness and intestinal tract irritation. Later, the intoxicated presents exhaustion, vomiting, thoracic and abdominal pain, muscle tremors, mental confusion, convulsions and comma.

For the instructor: Use the illustrated sheets that appear in this presentation, they will help you in the teaching process.
Signs and Symptoms of Organochloride Intoxication

- General discomfort
- Headache
- Dizziness
- Vomiting
- Nauseas
- Tremors
- Convulsions
- Coma
- Lack of breathing
Signs and Symptoms of Organophosphorus and Carbamates Intoxication

- Headache
- Contracted pupils
- Dizziness
- Abundant saliva
- Blurry vision
- Breathing difficulty
- Vomiting
- Transpiration
- Nauseas
- Tremors
- Stomach Cramps
- Diarrhoea
- Weakness
- Convulsions
- Comma
Signs and Symptoms of intoxication by Pyretrines and Pyrethroids

Tingling:
- in eyelids
- in lips

Conjunctive and mucous irritation

Sneezing

Intense itching

Spots in skin

Secretion and nasal obstruction

Excitation

Convulsions and comma

Lack of breathing
Signs and Symptoms of intoxication with Bypiridiles

Skin irritation
Conjunctive irritation
General discomfort
Weakness
Sore spots and burns in the mouth
Abdominal pain
Respiratory failure
Thirst
Bleeding nose
Lungs, kidneys and liver damage
Signs and Symptoms of intoxication with Herbicide of the Phenoxi Group

Appetite loss
Skin irritation
Dizziness
Intestinal tract irritation
Exhaustion
Nauseas y vomiting
Thoracic and abdominal pain
Muscular tremors
Mental confusion
Convulsions and comma
Lack of breathing
STEP # 6 PRESENTATION AND SIMULATION: FIRST AID IN CASE OF AN INTOXICATION WITH PLANT PROTECTION PRODUCTS.

The First Aid consists in the help that a person that is not a doctor could give to an intoxicated person with plant protection products, with the purpose of:

- to preserve his life
- to prevent health deterioration, and
- to promote the recuperation

It is convenient to remind that First Aid is useful to help and relieve the intoxicated person until he or she reaches medical assistance. First Aid cannot replace medical support.

The procedures of specific First Aid, according to the entrance route of the plant protection product to the organism, are described as follows:

**Intoxication by dermal via:**

- Act with rapidity avoiding the auto contamination during the procedure.
- Remove the intoxicated person of the area where the accident occurred (stop the exposition).
- Take off the contaminated clothing.
- Shower the intoxicated or wash the skin completely with water and soap.
- Ask for medical help and must carry the label and the pamphlet.
Intoxication by respiratory via:

- Act quickly avoiding to auto contaminate
- Remove the intoxicated person of the contaminated area
- Loosen the clothing of the intoxicated or take it off if it is contaminated, the skin must be washed with water and soap.
- Help the intoxicated person with artificial respiration or with oxygen by nasal via, if it is necessary.
- Ask for medical help and carry the label or the pamphlet.

Intoxication by oral via:

- Act quickly, stop the exposition, take off the contaminated clothing and shower the intoxicated person,
- Induce to vomit if there is no contraindication in the label or the pamphlet;
- Give a drink of activated coal suspension (3 pills of activated coal in half glass of water)
- Ask for medical help and carry the label and the pamphlet.
Intoxication by ocular via:

- Wash quickly any splash that occurs in the eyes during 15 minutes; with plenty of clean water, every ten seconds, must turn over the eyelids. Avoid contaminating the other eye.
- Do not wash the eye for more than an hour because it may cause dryness and the inhibit of the tear drops production.
- Cover and immobilize the eye using a clean and dry cloth.
- Ask for medical help, carry the label and the pamphlet.

In all cases of intoxication it is necessary to determine the causes that occasioned the accident, to execute the pertinent corrections.

For the instructor: Consult the document: First Aid: Procedures” that appears in annex, so that better options could be proposed.Organize work groups and assign them an intoxication by plant protection products case so they achieve a First Aid simulation.
UNIT 5.2 RISKS TO THE ENVIRONMENT

UNIT REVIEW

In this unit, the housewives would have the opportunity to know the environmental dynamic of plant protection products when they are applied over their crops. They would recognise that when a plant protection product is applied, many things may occur. At times, the products reach to the area that is going to be treated and keeps in it for a long time, producing residuals over the treated vegetables contaminating the food. Nevertheless, in other occasions, the product disappear rapidly after its application because it introduces in the environmental dynamic, whether it is evaporated, towards the atmosphere, leached, towards the subway waters; drained towards the superficial waters; absorbed or adhered to the soil particles; photolysed by the solar light action, etc; provoking air, soil and water contamination. In other occasions, the product does not even reach the designed treated area, on the contrary, it suffers dragging by the air currents and deposits in not desired areas, contaminating other environments. Besides they would know that the incorrect use of plant protection products might increase the resistance problem of the pest’s organisms and the population destruction of benefice organisms. To complement the process of teaching-learning would know some measures and actions that may be followed to diminish the undesirable effects or the plant protection products in the environment.

The titles of the main subjects are:
A. Environmental dynamic of plant protection products (Forms of how the products degrade)
B. Plants, water, soil, and air contamination;
C. Problem of resistance and destruction of the benefice organisms;
D. Measures to diminish the environmental impact.

OBJECTIVES

At the end of the activity, the participant housewives would be in capacity of:
- Identify and recognise the processes that implicate the environmental dynamic of plant protection products when being applied;
- Recognise the manners how the plant, water, soil and air contamination occur;
- Identify and recognise the processes by which, plant protection products can be degraded in the environment.
- Recognise the problem of the resistance and destruction of the benefice organisms;
- Take measures and actions to diminish the undesirable effects derived of the use of plant protection products
STEP # 1 PRESENTATION: ENVIRONMENTAL DYNAMIC OF THE PLANT PROTECTION PRODUCTS.

When plant protection products are applied, the objective is to contact these substances with the organisms that have reached its pest condition in most of the cases. A minor percentage of 5% enters in contact with the pest and a 95% remains in the environment. These products that remain in the environment start to be degraded by the action of diverse biotic and abiotic processes, for example: can be putrid by the action of the light, water, air and by diverse organisms, also can be adhered, vaporised, leached, drained and have a different destiny as planned initially, provoking contamination of other environments. Everything mentioned before constitutes the environmental dynamic for the plant protection products. To understand this dynamic, is very useful to know and predict the environmental risks that implicates the use of those products, likewise to adopt the measures and actions that permit to reduce or minimize them.

For the instructor: use the pictures that show the different stages and processes involved in the environmental dynamic of the plant protection products that appear in the next pages.

STEP #2 PRESENTATION: PLANTS, WATER AND SOIL CONTAMINATION; AND SOME ACTIONS TO MINIMIZE IT.

Many times the plant protection products have a different destiny that the one initially planned, that way provoke water, soil and air contamination. Likewise provoke contamination in our crops when we spray them with the purpose of protecting them from the pest organisms.

Plant contamination: The plant protection products can reach to the plant surface through some of the following actions, whether if it is in an individual or combined way: direct application, drag or drift effect, residual precipitations that are in the atmosphere and the irrigation with contaminated waters with rests of these products, once they reach the plants surface are metabolised and transformed, to activate or deactivate, increase or diminish the capacity of producing toxic effects for the same plant or for other organisms and contaminate the vegetables that we consume, making them no apt for its consumption, because they contain residual levels that surpass the maximum limits of residuals permitted and established by Comité Conjunto del Codees Alimentarius FAO/OMS. Some actions that can reduce this risks are: Use plant protection products that are authorized by the competent organism that watches for the harmless food; respect the lacking periods; avoid the crossed recontamination of other agricultural fields; application in adequate hours, to avoid drift and drag of contaminants; use good quality water, etcetera.

Water contamination: The contamination of superficial and underground waters with plant protection products can be provoked by various actions and/or processes, for example: direct applications, drift or drag during the application; deposit of soil
particles with remains of adhered products; drag of superficial layers of contaminated soils, wash dawn by rainwater; wash of application and protection equipment in superficial water fountains (rivers, lakes, ponds, etc) leaching of product residues localized in the application surface, etcetera. The establishment of mitigation areas is very important to avoid the contamination of water fountains, channels and irrigation ditches; the methods of soil management and conservation, also reduces the risks by this type of contamination to occur. To minimize these risks, must be followed the precaution measures and management that are offered in the label and pamphlet of the plant protection products.

**Soil contamination:** Soil is the final receptacle of residuals of plant protection products as water contamination, the actions and processes that take part in its contamination are the same.

**Air contamination:** The dynamic of plant protection products leftovers in the atmosphere is influenced by the product concentration in the air, the temperature, the wind, the product volatility, and other physicist-chemical characteristics. Processes as the evaporation, eolic erosion and the drift, are responsible for contamination. Some useful actions to reduce these risks are: to make the application in the freshest hours and without much wind, select products of lower volatility, select application technologies that reduce the drift and drag, etcetera.

For the instructor: use pictures that allow illustrating these types of contamination. Ask the growers about actions that can be done to minimize the environmental contamination. If it is possible make them all give new ideas.

**STEP # 3 PRESENTATION: RESISTANCE PROBLEM AND DESTRUCTION OF BENEVOLENT ORGANISMS**

Other of the environmental problems derived of the misuse of plant protection products, and that has repercussions over the control possibilities of pest organisms, are the resistance and the destruction of benevolent organisms. The application of plant protection products in a repeated manner, the dosage increment, the decrease of intervals between one application and other, the product mixture, the dependence of a unique control alternative, propitious the selection of pest organisms that can tolerate or resist higher dosage than the required to kill the majority of the population, at the same time destroys and/or reduces the benevolent organisms population. To manage the problem of resistance and destruction of population of benevolent organisms, the IPM adoption, the selective use of plant protection products and the guidance recommendations that appear in the label and the pamphlet would be some of the actions to follow.

For the instructor: make reference of experiences in which resistance is being reported, ask the farmers for this kind of experiences, make conclusions. Finish the activity with a summary.
The environmental destination of a chemical compound:

- Photodegradation in soil surface
- Washed by rainwater
- Microbiological degradation
- Leaching
- Plant absorption and transposition
- Soil adsorption, absorption and desorption
- Chemical degradation
- Volatilisation
UNIT # 6

SAFETY FOR FARMERS: PROTECTION FOR FARMERS THAT MANAGE AND USE PLANT PROTECTION PRODUCTS
UNIT # 6 SAFETY FOR FARMERS: PROTECTION FOR FARMERS THAT MANAGE AND USE PLANT PROTECTION PRODUCTS

UNIT REVIEW

The farmers and their families are a group of workers that with frequency are buying, transporting, give in doses, mixing, applying, eliminating and storing plant protection products. In dosage activities, mix and application, often have direct contact with the products, reason why they expose themselves to suffer some type of intoxication; reason why in the present unit the housewives will learn the necessary precaution measures to take to reduce the risks of suffering an intoxication; they will know the clothes and the personal protection equipment necessary and will learn to make some of these garments so that their husbands protect themselves in the accomplishing of these activities. Part of the unit will be the teaching of the personal hygiene measures that should be practised before, during and after having used plant protection products, the way of washing and keeping the clothing and the personal protection equipment.

The titles of the main subjects are:

A. Importance of the precaution and security measures during the management process and the use of plant protection products.
B. The clothes and the personal protection equipment.
C. The personal hygiene before, during and after the managing and use of plant protection products.
D. Washing and maintenance of the clothes and protective equipment.

OBJECTIVES

At the end of the activity the housewives would be able to:
- Recommend and adopt precaution measures, security and personal hygiene that are necessary to manage in a responsible way the product and avoid intoxications.
- To know the parts of the clothes and the personal protection equipment.
- Use the clothes and the personal protection equipment in a correct manner.
- To manufacture some parts of the personal protection equipment (mask, back protection)
- To wash in a correct manner and give maintenance to the clothes and the personal protection equipment.

TIME REQUIRED:

60 minutes.
STEP # 1: PRESENTATION AND DISCUSSION: PRECAUTION MEASURES, SECURITY AND PERSONAL HYGIENE DURING THE MANAGEMENT PROCESS AND THE USE OF PLANT PROTECTION PRODUCTS.

Always that a plant protection product is going to be used, you must keep in mind that these products are toxic and therefore dangerous for the user, for animals and environment, therefore they must be used with care. For the management and use of these products certain precautions and personal hygiene measures exist, that must be followed, to reduce the risk of suffering intoxication, here are some of them:

- **Correct identification of the pest organism.** If it is possible, use no chemical alternatives of management for its control. When the utilisation of plant protection products is strictly necessary, ask for advice to the specialists in this matter and select the appropriate product.
- **Read the label and the pamphlet.** Before using the product, it is indispensable requirement to read the label and the pamphlet, to understand the precautions and warnings of use, to know the symptoms and signs of intoxication and the agronomic information of the product presented. If one does not know how to read ask for help to someone who can.

- **Utilisation of clothes and personal protection equipment.** The tag and the pamphlet indicates the correct clothes and protection equipment, those recommendations should be followed.

- **Use the more adequate application equipment and review its good condition.** Do not use equipment with leaks and spillages, since this represents risks of skin contamination.
- **Avoid skin contamination.** When dosage, empty, pour and mix the concentrated product, avoid sprinkles or spillages over the skin or the clothes. If this may occur, take off the contaminated clothes and wash immediately the affected area with abundant water and soap if it is necessary. Wash also the contaminated clothes with water and soap.

- Use original products with warranty seal and label.
- Use containers and adequate equipment to measure, transfer and mix the products.

- Never use uncovered hands to mix or blend liquids.
- Always apply towards the wind and avoid getting in touch with the sprinkling.
- Avoid touching the leaves and plants recently sprayed.

- Clean the nozzles when obstructed the correct way, use water, a wood stick or a grass straw. Avoid its cleanliness blowing with the mouth or using a nail or wire.
- Do not eat, drink or smoke, while plant protection products are been used or managed.

- Do not touch with the hands or dirty gloves, the face or other skin area.

- Before eating, drinking or smoking always wash the hands and the face.

- Take off the contaminated protection clothes, wash them daily and separated from the rest of the family clothing.

- Shower with abundant water and soap after each application activity and dress with clean clothes.

For the instructor: Use illustrated sheets or photographs that demonstrate good and bad actions. Discuss and anime the growers to point the failures.

STEP # 2. PRESENTATION AND DEMONSTRATION. THE CLOTHES AND THE PERSONAL PROTECTION EQUIPMENT: CORRECT WAY OF DRESS AND UNDRESS.

To reduce the intoxication risks, besides the used precautions and personal hygiene measures described previously, the use of clothes and personal protection equipment is recommended. The basic components of clothes and personal protection equipment include:

- Long sleeve shirt and long pants, both should not have pockets or bags;
- Rubber gloves without lining;
- Rubber boots without lining;
- Wide wing hat;
- Impermeable apron or gabardine;
- Glasses or face protective mask;
- Masks and/or breathing filters when extremely dangerous products of are going to be used.

For the instructor: Provide of different types of suits and protection equipment and give them to the growers so they see and analyse them, respond to their questions. Explain the correct manner of using the suits and the equipment. Explain the correct manner of taking it off.
TYPES OF PROTECTION SUITS
STEP # 3. PRESENTATION AND DEMONSTRATION: EQUIPMENT DESIGN AND PROTECTIVE CLOTHES.

A good number of farmers do not use all the clothes and the personal application equipment for different reasons; some argue incommodiousness; others the high cost of the components, and also exist those do not know its importance.

The truth is that there is no cheap clothes and protection equipment, flexible, easy to use, and that at the same time provides complete protection.

Nevertheless, there are alternatives for people of limited resources, that can be done according to the characteristics of each country and that offer an acceptable degree of protection.

It is convenient to indicate, that the inadequate clothes and protection equipment or the carelessness in its maintenance and washing can increase the risks instead of diminish them.

In the enclosed material are proportioned, some designs to make clothes and some protection equipment.

For the instructor: Make a demonstration of how to make the clothes and protective equipment with local resources. Ask the farmers to make a plastic apron and a mask using plastic containers.

STEP # 4: PRESENTATION: WASHING AND MAINTENANCE OF THE CLOTHES AND OF THE PROTECTION EQUIPMENT.

The clothes and the personal protection equipment should be kept in good conditions so that it does not have breaks or worn out parts from where the product can contaminate the skin. The boots should be examined frequently so they can be repaired or changed according to the case. The clothes and the other parts of the equipment should be washed at the end of each working day with water and soap. It has to be washed separated from the clothes of the rest of the family and put it away.

For the instructor: When the unit is ended, makes a recapitulation. Make questions to the growers. Clear up doubts if there are questions.
TWO PIECE PROTECTIVE SUIT

(All dimensions in centimeters)
ONE PIECE SUIT

(All dimensions in centimeters)

ALL EDGES FOLDED AND JOINT BY HEAT

SHOULDER JOINT OF DOUBLE THICKNESS AND JOINT BY HEAT

ALL CORDS OF DOUBLE THICKNESS FOLDED AND JOINT BY HEAT

TOTAL 200
PROTECTIVE MASK

(All dimensions in centimeters)

FOAM BAND
28 cms long (in the back)

SUBJECTION STRIPE (VELCRO TYPE)
28 cms long (in front)

FLEXIBLE ACETATE
(FRONT)

ROUNDED EXTREME

*Sponge
ALTERNATIVE CLOTHES

This kind of cloth and protection equipment is of low price and some of the garments can be manufactured by the same farmer and/or housewife with easy acquired resources.

MATERIALS

- Cap or hat
- Long sleeve shirt
- Plastic bags or gloves
- Pants
- Boots
- Plastic apron (It can be done using a meter of plastic)
- Mask (It can be done using a plastic bottle)
- Two meters of plastic rope or strap
- Adhesive tape
- Scissors
- Jackknife / knife
- Marker
- Meter (Ruler)
- Rubber bands
STEPS TO MANUFACTURE A PLASTIC APRON.

REQUIRED MATERIALS: Scissors, marker, meter, rubber bands, adhesive tape, a meter of thick nylon.

Step # 1: Cut the meter of nylon in one of the extremes, as shown in the photograph.
Step #2: Fold the meter of nylon in half. Mark in the corner of the fold with a marker a ratio of 10.5 centimetres to make the neck hole in the apron, observe the photograph.

Step #3. With the scissor cut the mark in the fold to make the hole for the neck. Extend the apron and would remain a similar to the figure on page 188 of this manual.
Step # 4. Make a cut of 2 centimetres long, in a localized point at 70 centimetres from the inferior extreme of the apron and 4 centimetres of the closest edge. As shown in the photograph. Repeat the same operation in the opposite side.

Step # 5. Using adhesive tape reinforce the surrounding areas to the place where the described cuts in previous step were done to get a long lasting apron.
Step # 6. Cross an plastic rope or strap of 2 meters long by the cuttings previously done, this will permit you to fasten the apron to the waistline.
Step # 7. Congratulations! You have made your own a protective apron.

PROCEDURE TO MANUFACTURE A PROTECTIVE MASK

Step #1 Use a disposable plastic bottle of 2 litres, using 2 rubber bands as a guide and a marker to delineate the places where the cuts are going to be done to eliminate the tip and the bottle base. The photograph illustrates the procedure.
Step # 2. Using a cutting tool, make a hole where the respective cuts should initiate. Observe the photograph for a better comprehension.-

Step # 3. Cut the tip and the bottle base, leaving the cylinder that forms the central part.

Step # 4. Proceed to cut the cylinder as shown in the photograph. The clearest and more transparent part should remain intact, since it is going to be used in the front the face.
Step # 5. Adjust the plastic lamina obtained at your face size in order to be able to cut the excess. Observe the photograph.

Step # 6. Cut the plastic lamina excess, as shown in the photograph.
Step # 7. With a cutting tool, make two lateral holes in the plastic mask. These holes would be used to place the plastic rope or strap that would permit you to fasten the mask to your head.
Step # 8. Cover the mask edges with adhesive tape to avoid being injured by the plastic edges when placing the mask over your face. Observe the photograph. Other alternative could be to refine the edges.

Step # 5. Congratulations! You can now wear your mask with a hat.
Step # 6. **Very Well!** If you made a cut of 20 centimetres long in the upper part of the mask, this can also be used with a cap.
UNIT # 7 PURCHASE, TRANSPORT, STORAGE AND ELIMINATION OF EMPTY CONTAINERS FOR PLANT PROTECTION PRODUCTS.

UNIT REVIEW

In this unit, would remember the growers the importance of identifying the pest’s organisms that exist in the cultivated fields; before the selection of the most adequate plant protection product. Then they would learn and recognise, that at the moment of the purchase, must assure that the products are in good conditions and are originals. They would also learn the rules to accomplish safe transportation and storage of plant protection products, thus the correct elimination of residuals.

The titles of the main subjects are:
A. Purchase of the adequate product
B. Rules for the correct transportation
C. Rules for the correct storage
D. Rules for the correct elimination of residuals

OBJECTIVES

At the end of the activity, the participant growers would be in capacity of:
- Selecting and acquiring the most adequate plant protection product to the phytosanitary problem in their crops.
- During the purchase be able to examine the condition of the containers of plant protection products (label, guarantee seal, etc.)
- Transport the plant protection products in a correct and safe way;
- Store the plant protection products in a correct and safe way, and
- Eliminate the correct way the empty containers, residue and remainders of plant protection products.

TIME REQUIRED

45 minutes.
STEP # 1 PRESENTATION: PURCHASE OF THE ADEQUATE PRODUCT

Before buying a plant protection product, it is important to identify the phytosanitary problems that exist in the crop. To be sure that the selected product is the correct one, it is convenient to ask specialists in this matter for advice. Before using the product the label and the pamphlet instructions should be read carefully.

At the moment of the purchase, examine that the products is original, that the container is correctly label and is not in bad condition (poured and/or dented), and besides make sure it has a guarantee seal.

Do not accept damaged containers (broken or poured) or those are not the manufacturer’s originals, or that are inadequately tagged; since this may provoke problems during the transportation, use and storage. Remember that the repacking of plant protection products is an illegal activity.

For the instructor: Use illustrated sheets or photographs, where the correct and incorrect is presented. Ask questions to the growers and analyse their answers. Motivate their participation. You can help yourself with the enclosed visual material.
STEP # 2 PRESENTATION: RULES FOR THE CORRECT TRANSPORTATION

In order that the transport operation is as safe as possible and to be able to react efficiently in case of an accident; in the dealings and places where the farmers or other members of the family buy plant protection products, the following norms must be followed, paying special attention and assure that no persons or their belongings and food products are in risk for leaks or contaminated containers.

Separation between passengers, cattle and merchandise. Whenever it is possible, plant protection products should not be loaded in vehicles that transport passengers, animals, foods and other substances for human or animal consumption. If this is not possible, then separate the plant protection products as much as possible, from the passengers and of the rest of the luggage.

Safe load. Load and unload plant protection products containers carefully. Never put over them heavy merchandise that might flatten the containers, nor throw them from the height. Surpassed nails, metallic stripes and splinters of wood that might exist in the vehicles, can perforate the containers and produce spilling; all these obstacles should be eliminated before loading. After the unloading, the vehicle should always be cleaned.

For the instructor: Follow the indicated procedure in the previous step.
STEP # 3 PRESENTACION: NORMS FOR SAFE STORAGE

The plant protection products are expensive merchandise that could be damage and remain useless, inclusive they can be dangerous if they are not stored in the adequate conditions. Read the label and the pamphlet and follow the storing instructions, avoid especially extreme temperatures, it is safe to do so. It is necessary to plan the purchases with care, to reduce the storing time and avoid residuals. The storing places should be safe, out of the reach of the children and no authorised persons, animals, foods and water fountains. The food and drinks containers should never be used to keep these products. In the field, it is very important to avoid storing these products in houses, keep these products in their original containers and correctly closed, keep them out of the reach of the children, preferably locked in independent boxes, and where they can never be confused with foods or drinks. It is very important to keep them dry, but far away from the fire, and in a place where they do not receive the sunlight directly.

For the instructor: Use the procedure in step # 1

STEP # 4 PRESENTATION: NORMS FOR THE CORRECT ELIMINATION OF RESIDUALS

The following are considered residuals of plant protection products: subdued products, residuals and/or pouring, diluted products, empty containers, contaminated clothes and materials used for cleaning spills and application equipment.

To avoid the trouble that means the elimination of residuals, the responsible management of plant protection products from the moment of its purchase until the application, is important, since this can reduce the complications.

Undoubtedly residuals are always produced, which should be eliminated through safe methods. For those who practice safe elimination methods, clean the areas and contaminated objects to reduce the environmental contamination.
The general principles that should be fulfilled are:

- Always obey the local legal rules according to the theme.
- Always eliminate residuals when they happen; avoid the accumulation of big quantities.
- Read the label and pamphlet of the product to know the specific instructions.
- Ask for the advice of an expert when doubts may come.
- Eliminate residuals in a way to avoid the risk of people, domestic cattle, fauna and wild flora, crops, stored foods or water fountains.

Procedure when a spill occurs:

If a spill occurs, proceed as follows:
- Use the clothes and personal protection equipment.
- Keep away people and animals.
- Do not smoke, or use illumination with free flames close to the spilling.
- Damaged containers should be removed far away from the housing and water fountains and where the soil can absorb the spill.
- Stop the spill using ground or sawdust, sweep carefully the contaminated material, pick it up and bury it, where there is no possibility to contaminate the spring and water sources.
- Wash carefully all contaminated areas with water and soap.

If someone gets contaminated:

- Take off and wash the contaminated clothes.
- Wash repeatedly the skin affected, with water and soap, if it is necessary ask for medical help.

If any foods has been contaminated:

- Burn or bury deeply in the ground. The contaminated foods should never been eaten or given to animals. This might be fatal.

Procedure to eliminated empty containers: Triple-wash.
After using plant protection products the containers remain empty, with residuals of the used product, and that need to be discarded in a correct and safe way, to avoid the contamination of human beings, domestic animals and the environment (air, soil and water). It should be remind that the containers of plant protection products should never be used for human or animal consumption water or food.
It has been proven, for example, that empty containers of liquid formulations can keep in its interior certain product quantity, thus a container of 20 litres can retain 60 millilitres of the original concentrate. Therefore, before its elimination and final deposition should be subject of triple wash to obtain economy, health and ecology, for that the procedure that appears in the illustration of page 100 should be followed. The containers triple washed should be perforated to make them useless and then taken to the closest collect centre for its destruction.

For the instructor: Besides the presentations, make demonstrations of the safe and correct way to stop and clean up a spill and the safe way to manage and eliminate the empty containers.
TRIPLE WASHING

3 TIMES

1. Water up to 1/4 of the vessel
2. Squeeze, shake for 30 seconds
3. Pour the water into the sprayer pump
MINICENTRE OF CROP PROTECTION PRODUCTS
EMPTY CONTAINERS RECOLLECTION TRIPLE WASHED AND USELESS
COLLECT CENTRES OF PLANT PROTECTION PRODUCTS EMPTY CONTAINERS
UNIT # 8

MANAGEMENT AND MAINTENANCE OF THE APPLICATION EQUIPMENT
UNIT # 8 MANAGEMENT AND MAINTENANCE OF THE APPLICATION EQUIPMENT

UNIT DESCRIPTION

In this unit farmers would know the construction of the types of aspersion equipment (knapsack sprayer) of common use in the local job. They would also learn the way to use it, repair it and give maintenance.

The titles of the main subjects are:

A. Types of sprinkler and knapsack sprayer.
B. Construction of the knapsack sprayer.
C. Maintenance and reparation of the knapsack sprayer.
D. Use of the knapsack sprayer.

OBJECTIVES

At the end of this activity the participant farmer would be in capacity of:

- Identify the most common types of sprinklers or knapsacks sprayers at work;
- Describe the construction and function of these equipment;
- Dismantle and assemble again a knapsack sprayer;
- Identify and name the nozzles (tip) of use in the zone;
- Indicate what plant protection products can be applied with them;
- Demonstrate to be able to verify the good functioning of the application equipment;
- Put a knapsack sprayer on the shoulders without help;
- Maintain constant pressure in the aspersion or pulverisation equipment; and
- Demonstrate the effect that the type or status of the nozzle, the pressure, the passing and the height of the nozzle with respect to the treated objective, has in the application dosage and the cover.

TIME REQUIRED

3 hours
STEP # 1 PRESENTATION:
TYPES OF SPRINKLERS OR SPRAYER EQUIPMENT

In most countries in development, the application of plant protection products is done using manual sprinklers or small hydraulic sprayers. According to the crop practices and the economic development of an area, fog machines, motorised sprinklers mounted in tractors or airplanes, rotating disc sprinklers and fumigators. Besides that, there exist special equipments or adapted to apply formulations in powder or granules.

The most common types of sprinklers or sprayer are the following:
- Pre-pressure backpack or knapsack sprinklers;
- Knapsack sprinklers operated manually (piston type and diaphragm type)
- Motorised knapsack sprinklers
- Handy type sprinklers for herbicides;
- Manual sprinklers with rotating disc (applicators for herbicides or insecticides)

For the instructor: For this presentation help yourself with the enclosed audiovisual material, besides provide yourself of several of the mentioned equipment for its demonstration.

PRE-PRESSURED BACKPACK SPRINKLER AND ITS PARTS
SPRINKLER OF CONSTANT PRESSURE
CONSTRAINT PRESSURE SPRINKLER
(A) INTERNAL PISTON  (B) EXTERNAL PISTON
MOTORIZED KNAPSACK SPRINKLERS AND THEIR PARTS
HANDY TYPE SPRINKLERS FOR HERBICIDES AND ITS PARTS

- Interchangeable nozzle. Spraying turbine with electric engine and revolving disc 2200 r.p.m.
- Mixture conduit
- Air way
- Stabilizer plate with a 0.5 mm mesh filter
- 5 liter Can containing the liquid herbicide works as a tank
ULVA APPLICATOR (FOR INSECTICIDES) AND ITS PARTS
STEP # 2 PRESENTATION AND DEMOSTRUCTION: CONSTRUCTION OF THE SPRINKLER OR THE KNAPSACK SPRAYER.

Every knapsack sprayer is formed by the following components:
1. The cap of the tank. This has a vent that should be cleared up in every moment to permit the air entrance.
2. Tank filter. Under the cap and on the tank entrance, there is a filter that does not allow the entrance of sweepings and other dirt. Every time the sprinkler is full, the filter should be in its place.
3. The tank. The function of the tank is to contain the mixing that is going to be applied, its capacity can change according to the equipment size, there are of 10 or 20 litres and of different materials.
4. The pump and the compressor deposit. Generally the pump is of diaphragm or piston. The compressor deposit maintains the liquid pressure when the pump is functioning, and it could have an incorporated variable pressure valve, which would produce the pressure that the operator has selected.
5. The pump rod. Is generally at the right or left side, according to the manual ability of the operator.
6. The hose. Allows the connection of the pump towards the sprayer valve and the spray gun.
7. The pulverization valve and spray gun. The sprayer valve normally contains one filter, which should be checked regularly, the same as the system gasket
8. Nozzles, peak-axe or tips. Is at the end of the spray gun and could be of two types: fan nozzles and cone nozzles (fixed or variable). Use the enclosed audio-visual material for its better description and provide guidance of nozzles selection.

For the instructor: For this presentation use protector clothes and part of the personal protection equipment. In this presentation and demonstration it should refer to the type or types of sprayer and nozzles of the most common use in the zone and should limit to the knowledge and techniques that would help farmers. Make a brief demonstration over the construction and the equipment components. A logic way of accomplish this, is following the liquid motion through the equipment, as these advances from the cap to the nozzle, dismantle, describing and explaining the function of each component. Use real sprayer, to save time, before the presentation loosen the screws and/or dismantle the sprayer partially. Also use the enclosed educational materials.
1. Resistant and easy to assemble handle.
2. Wide filter in the spray guns handle with an incorporated closing system and quay.
3. Fixative in passing handle.
5. Filling filter with content indication.
6. Mechanical agitator with device to assemble the closing valve.
7. External level indicator in liters and gallons USA.
10. Record for accessory assemble indicated in this catalog.
11. Fastening spots for the belt. (accessory).
12. Regulating conical nozzle.
13. Replaceable nozzle for herbicides. (only Mod. Super Agro 16).
14. Pump hose with nuts, without brackets.
15. Exit record in strait angle incorporated in the camera.
16. Fixative of crowbar, spray gun and arm to make easier the transportation and storing.
17. Operating crowbar with ergonomic handle.
18. Guide nut with closing and lubricating washer.
19. Transportation handle.
20. Resistant and adjustable straps.
21. Pressure camera, eccentric and monopiece of high capacity and resistance.
22. Rubber retainer.
23. Reversible model. (See instructions).
24. Inox. balls in valve and shirt.
25. Antischock and anticorrosive complete base.

PARTS OF A SPRAYING PUMP
CONE SHAPED NOZZLE COMPONENTS WITH CHANGEABLE DISCS

FLAT FAN SHAPED NOZZLE COMPONENTS
NOZZLE TYPES

- DG TeeJet
- TeeJet
- TwinJet
- ConeJet
- TG Full Cone
- Disc-Core
- TeeJet UB
## NOZZLE SELECTION GUIDE

<table>
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<tr>
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<th>Fungicides</th>
<th>Insecticides</th>
<th>Liquid Fertilizers</th>
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<td><strong>Turbo Teejet</strong></td>
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<td><strong>Twinjet</strong></td>
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<td><strong>TG Full Cone</strong></td>
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<td><strong>Quick Teejet</strong></td>
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<td><strong>Streamjet</strong></td>
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**NOTICE:** Read the label of the chemical product for the specific recommendations of dosage and applying volumes.
STEP # 3 DEMOSTRATION: INSPECTION AND MAINTENANCE OF THE KNAPSACK SPRAYER

This exercise should be done in the field, the importance of cleaning and keeping the sprayer equipment in good conditions should be repeated often, mainly what it refers to filters, nozzles, valves, gaskets and hoses, to avoid obstructions, leaks and pouring which means risk to the security of the operator.

Use the clothes and personal protection equipment and demonstrate the inspection series that should be executed to avoid those problems. For example:

01. The cap should be clean and the breather free of obstructions, always put the cap downwards.
02. The cap filter should be clean. Place the filter in the cap turned upwards to keep it clean.
03. The pressure valve should be adjusted according to the use of the herbicides (low pressure) or insecticides and fungicides (high pressure).
04. The tank interior should be clean. If not, it should be washed.
05. The mixture agitator in the tank should be in good conditions. Some equipments do not lack of agitators.
06. The hoses should be in good conditions, the bracket and connections too.
07. The shooter should be in good conditions and the filter should be clean. If it is necessary, it should be lubricated.
08. All connections should be clean and adjusted. Review the good condition of the gaskets.
09. The nozzle should be the appropriate to the product that will be applied and be clean. The filters should correspond to the formulation type of the product to be used and to be cleaned. The connections and gaskets should be adjusted. If the nozzle is dirty, clean it and if it is damaged, change it.
10. The stripes should be reviewed and cleaned. Adjust them if necessary. The sprayer weight should rest over the shoulders and not in the back.
11. Make the sprayer function and review that there are not leaks.
12. Spray over a flat surface to verify the uniformity of the sprinkler pattern. If the pattern is irregular, the nozzle should be changed.

For the instructor: Demonstrate a series of inspections. Remember that the list should be adapted to the sprayer you are using. After of its demonstration, organize work groups and make farmers practice.
SEQUENCE TO BE FOLLOWED IN THE MAINTENANCE OF A SPRINKLER
SEQUENCE TO BE FOLLOWED IN THE MAINTENANCE OF A SPRINKLER

(FOR THE PUMP ASSEMBLE CONTINUE IN THE OPPOSITE DIRECTION)
STEP # 4. PRESENTATION AND DEMONSTRATION: USE OF THE KNAPSACK SPRAYER

To obtain a successful application it is very important that the surface covered by the sprinkler is applied uniform and that the drops are equal and fine, this depends on the pulverization equipment. Of course, what is understood for “correct application” it depends of other factors as the type of plant protection product, the crop, land topography, the environmental conditions, land, etc. However, this can be obtained when modifying some factors, as for example:
- The type and state of the nozzle
- The work pressure, controlled by the pumping,
- The step velocity of the operator and of the nozzle,
- Nozzle sprinkler angle, and
- Nozzle height to the objective.

The following practical exercises demonstrate how these factors can be modified to obtain the desired coverage. In these exercises two important aspects should be remembered:
- An application (spray) generally last several hours, therefore it is important to obtain a comfortable working rhythm, and
- It can be that in the working place, there is not enough equipment (for example nozzles) and it would be necessary to manage to be able to solve these situations.

Some of these modifications can be obtained accomplishing the following actions:
1. Change the sprayer nozzle and indicate the nozzle variety that exists in the market.
2. With the tank full, put on the knapsack sprayer without help. As shown in the figure.
3. Put the spray gun with the nozzle inside a bucket, pulverize during a minute and measure the unloaded quantity.
4. Make that exercise with different pressures (when possible). Make brief commentaries and identify the existing variation reasons.
5. Accomplish the same test for different nozzles.
6. Demonstrate the band width of different nozzles over an even surface (the nozzle should be at a constant height).
7. Finally demonstrate the effect that has the nozzle height and the step velocity in the application coverage.

For the instructor: Organize groups and motivate the farmers to practice these exercises. Remember they should work with protective clothes and protection equipment. End the activity making a calibration exercises. Get protection equipment, tape measure, buckets, nozzles and a watch.
HOW TO PUT ON THE KNAPSACK WITHOUT HELP

1. 

2. 

3. 

4. 

5. 

6. 

7.
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FIRST AID IN CASE OF INTAXICATION WITH PESTICIDES
FIRST AID IN CASE OF INTOXICATION WITH PESTICIDES.
Shoes, C. & Collier, C. Adapted C. Palacios.

SYNTHESIS.
The first aid is the initial effort to assist a patient while the medical help is on its way. If these procedures are administered immediately when intoxication with pesticides is suspected, can constitute the difference between to save or loose a patient.

PREPARATIONS:
Before describing the management procedures of first aid in connection with the use of modern pesticides, it is important to emphasise that wherever the pesticides are stored, managed or employed, the following elements for first aid should be on hand.
(1) Water supply
(2) A soft soap and cloth to wash the skin, and
(3) Domestic remedies and antidotes that could be employed before transporting the patient to a medical installation.

Of the various antidotes that have been recommended for treatment of first aid in an intoxication, one of the most useful is the charcoal. Charcoal is essential for the treatment of intoxications by pesticides first aid due to ingestion and should be available for its immediate use. When it is administered in an adequate dosage, this absorbent inhibits the gastrointestinal absorption of an ample spectrum of chemical compounds. The activated charcoal, a fine black powder, odourless, insipid, is the destroyer of distillation residuals of different organic materials, for example: wood pulp, treated adequately to increase its absorption power. (Hayes, 1970)

There is a pharmochemical quality of activated charcoal that usually can be bought in any drugstore. Nevertheless, when there is no drugstore available, at home you can obtain an acceptable quality of common charcoal that can be employed to treat intoxication cases. A common practice is to burn breadcrumbs heating them in a semi-closed container until it is completely carbonized. A good quality, perhaps better, of common charcoal can be done by heating wood splinters in a closed container to exclude air in the burnt process.
The wood should be brushed or cut in small splinters and heat them until they carbonize completely. A particle can be proven breaking it sporadically to determine if it has blackened complete. The heating should continue, excluding the larger quantity of air as possible, until there is no domestic charcoal smoke. This can then be sprinkle with powder or destroyed in pieces with the hands and stored in a bottle for use in case of intoxication (Freed, 1981)
The activated charcoal is only superior to the universal antidote (2 parts of activated charcoal, 1 part of oxide of magnesium and 1 part of tannic acid) or the domestic equivalent (2 parts of burnt toast, 1 part of magnesium milk and 1 part of tea) and should always be employed.
Another preparation that should be on hand is the ipecac syrup, to induce the vomit in case of ingesting a toxic substance. The dosage is of 2 spoons for adults and 1 teaspoon for children. NOTE: Ipecac syrup, NO fluidextract.

**PROCEDURES IN CASE OF INTOXICATION WITH PESTICIDES.**
The first step in an intoxication emergency, except if you are alone with the patient, is to call a doctor and/or the ambulance or any vehicle that can transport him or her to the closest clinic. If you are alone with the patient, watch that the breathing is regular, the pulse adequate and that it does not occur any additional exposition. While you wait for the doctor or vehicle, or even while the patient is been transported to the hospital, these first aid procedures should be followed:

**INGESTED PESTICIDES**

Procedure:
1. If the pesticide is unknown, administer any of the following adsorbent agents through the mouth.
2. Activated charcoal: preferred for all toxic substances except cyanide and bypiridiles. Dosage – 30 grams in 100 millilitres of water (3 tablespoons in half glass of water) as a thick suspension, or if the activated charcoal is not obtained, administer beaten egg whites. Dosage – 8 egg whites for adults; 4 egg whites for children.
   In the case of paraquat, an adsorbent clay as the Füller's earth is preferable to the activated charcoal. If clay is not obtained, then no contaminated land should be administered, then take the patient to the hospital.
3. If the pesticide is known, induce to vomit if it is recommended in the pesticides label and there are no contraindications. After vomiting, administer the activated charcoal in 100 millilitres of water (3 tablespoons in half glass of water) or beaten egg white, if there is no charcoal. Take the patient to the hospital.

**VOMIT INDUCTION**

If the identity of the pesticide is known, induce to vomit if it is recommended in the label. The ipecac syrup or the vomit by mechanic stimulus are two methods employed to induce vomiting. The ipecac syrup, administered through the mouth can eliminate the 90% to the 100% of the stomach content. The dosage is 2 tablespoons for adults and 1 teaspoon for children. Note ipecac syrup, NO fluidextract.
Figure #1 VOMIT BY MECHANIC STIMULUS

Vomit by mechanic stimulus: Mechanic stimulation of the throat is where the index finger is used to induce the vomit. It is advised to use the first two fingers of the other hand to push the patient’s cheek between the teeth to assure that he does not bite the index finger. See figure #1. This procedure can extract a 50% of the stomach content and can be done immediately. As soon as the vomit occurs within a few minutes, provide the patient activated charcoal.

Procedures to avoid in cases of pesticide ingestion

1. Contraindications to the vomit induction. **Do not induce the vomit if the patient:**
   - is sleepy, unconscious or with convulsions, the patient could choke and die if the vomit is induced.
   - has swallowed a corrosive poison, because the product will burn the throat severely going back as it did when was ingested. Examples are the strong acids and alkalis as phenols and alkaline salts. The patient would complain of severe pain and would have signs and symptoms of mouth and throat burns.
   - has ingested a pesticide on petroleum base. Most pesticides that come with liquid formulations are dissolved in petroleum derived products (xylene, kerosene, etcetera.)
   - The words emulsifiable concentrate or EC in the labels are signs of not inducing vomit, if the patient has ingested a concentrate. If the patient has swallowed a diluted form of these products, nevertheless should force to vomit immediately.
   - If the patient is in the last three last months of pregnancy

2. The use of salt (NaCl) to induce vomit should be avoided because a severe intoxication may occur with salt in fruitless attempts to induce vomiting (Gleason etc. Al., 1976)

3. More than two dosages of ipecac syrup should not be administered because this drug is harmful to the heart. The ipecac fluidextract should never be used to induce vomit because is fourteen times more concentrated than the syrup. (Arena, 1978).

4. Do not administer baking powder, sodium bicarbonate and other carbonates in case of ingesting acid pesticides, because this can induce to the intestines perforation through the sudden emission of carbon dioxide.

**Inhaled pesticides**

**Procedure:**
1. If the patient is in a closed space, do not go for him or her without a breather mask.
2. Carry the patient (do not let the patient walk) to take fresh air immediately.
3. Open all doors and windows
4. Loosen adjusted cloth.

**Pesticide in the skin**

*The more rapid the pesticide is washed from the victim, the smaller the lesion would result.*

**Procedure:**
1. Take off contaminated clothes
2. Submerge the skin in water (shower, hose, faucet, pool, irrigation channel, etc.)
3. Clean the skin, hair and nails slowly with pure soap and water. The detergents and commercial cleaners can increase the absorption of the pesticide (Maramba, 1980)
4. If water and soap are not immediately obtained, employ a clean and dry cloth to take off as many pesticide as possible from the skin and wash as soon as possible.
5. For chemical burns, cover immediately, without tighten, with a clean and soft cloth after washing with large quantities of current water.
6. Avoid the uses of ointments, greases, oils, powders and other drugs in the treatment of first aid of burns.

**Pesticides in the eye**

**Procedure:**
1. Maintain the eyelids open and wash the eye with a soft spout of current water immediately. Do not press.
2. Be careful not to contaminate the other eye, if only one eye is affected.
3. Continue the washing during 15 minutes.
4. Do not employ chemical products or drugs in the washing water because this may increase the grade of ocular lesion.
5. Turn down first to the upper eyelid and then the inferior and clean them with a wet cotton to extract any strange body.
6. Irrigate the eye once again.
7. Do not exceed more than one hour washing the eyes because dryness may provoked or inhibit the production of tears.
8. Cover the eye with a little piece of clean cloth and send the victim to the doctor, preferable an ophthalmologist.

**Other first aid procedures:**
1. Cleaning of the respiratory via and posture – is always imperative to assure a clean respiratory via extracting any strange body, as teeth, foods and secretions of the mouth and the nose, put the patient in the recovery position with the head extended and 15 to 30 degrees lower than the trunk level.
Figure # 2 KEEP THIS POSITION WHILE YOU WAIT FOR THE DOCTOR OR THE VEHICLE AND WHILE THE PATIENT IS BEING TRANSPORTED TO THE HOSPITAL

This position:

1. Prevent obstruction of the respiratory tract due to the relaxation of the tongue and other soft tissues. If the tongue has already slipped to the throat, it should be thrown outside.

   - Prevent the aspiration of the vomited material in the respiratory tract.
   - Increase the drainage by gravity of the secretions of the respiratory tract.
   - Prevent the additional transit of the stomach content in the thin intestine.

2. Bring the patient to the clinic or hospital. DO NOT WASTE TIME, MAKE IT QUICKLY.
3. Breathing maintenance – if the respiratory movements are inadequate or non-existent, apply artificial respiration employing a bag "ambu" or respiration mouth to mouth. See figure # 3.
4. Circulation maintenance – when the pulse disappears all of a sudden and there are no detectable heart bits, apply external massage. See figure # 4.
5. Unconsciousness – never administer anything by the mouth and assure that the tongue is suspended towards in front when inserting a small blunt and hard object as a spoon or a tongue depressor, between the tongue and the palate.

6. Convulsions – insert a quilted gag between the jaws to prevent that the patient bites his tongue. Prevent additional injury by placing a pillow or a cushion under the head and not letting it fall. See figure # 5.

7. Prophylaxis and antidote medication of first aid – the atropine sulphate and the oxyms should not be ingested by the pesticide users as a prophylactic measure because they do not prevent the intoxication. Indeed, they can create a false security sense and retard the first aid administration procedures and definitely medical treatment. The sulphate of atropine pills can disguise or retard the first
intoxication symptoms and that can be prejudicial at least in two manners. The workers can go back to their work and receive more exposition or, the worker is carried to a doctor, to whom he doesn’t inform that he has already taken atropine, the intoxication diagnosis can loose or retard. In an emergency of acute intoxication, if the victim is stunned or vomiting, do not employ oral atropine as first aid measure because the dosage is too small and the victim cannot swallow. (Anón, 1974)

8. Pesticide identification – If it is possible, take the pesticide container, label or pamphlet with the doctor, in a safe way. If it is impossible, make sure he knows what type of pesticide the patient has been using. See figure # 6
GLOSSARY
ABIOTIC: Not living environmental factor. For example; The climate.
ABSORPTION: Process by which a plant protection product is absorbed by the plants tissue.
ACARUS: Invertebrate small animal (almost microscopic) with a oral system ended in tweezers.
ACARICIDE: Product for the plant protection use to kill mite.
ACTION MODE: It is the way how a plant protection product penetrates or acts in an organism that wants to be controlled.
ACTION SPECTRE: Concept that refers to the number of organisms that a plant protection product can control, for example: a monotoxic of aphicide action only kills aphids.
ACTIVE INGREDIENT: The biologically active part of a plant protection product present in a formulation.
ADHERENCE: Process by which a substance is adhered to the surface of a solid or a liquid.
ADHERENT: An additive that helps the pulverization dew (aspersion) adheres (to glue) for example adhering to the surface of an object.
ADDITIVE EFFECT: The complementary action of two or more chemical products that produces an effect similar to the addition of the individual effects.
ADULTERATED: Any product for the plant protection that has been illegally manipulated and whose purity and efficacy are inferior to the quality specified in the label.
AEROSOL: A fine cloud of solid and liquid particles suspended in the air.
AGROECOSYSTEM: Agricultural production system where the humans hand participation is necessary, for example: a crop.
AGUILON: Bar where the nozzles of an agricultural sprayer are mounted and goes parallel to the floor during the application.
ALIMENTARY CHAIN: a series of live organisms, which each of them eats the one that precedes it. For example: the rabbit eats grass, and the coyote eats the rabbit.
ANTAGONISM: An organism or substance that affects life negatively or to the effect of other organism or substance.
ANTHRACNOSE: Illness that shows depressed injuries of dark colour in leaves, stem and fruits.
ANTIBIOSIS: Inhibition or destruction of an organism by means of a metabolic product of another.
ANTIBIOTIC: A substance that is used to destroy pathogen.
ANTIDOTE: Against poison. For example a treatment that is given to oppose to the effects of a toxic substance.
ANUAL: Plant that germinates, blooms, produces seeds and dies in one year.
APHICIDE: Product for the plant protection use to kill aphids.
APPLICATION RATE: quantity of any applied material per unit of length, surface or volume.
ARTHROPOD: Invertebrate animal with appendices (feet, wings, antennas) provided of articulated pieces.
AUTOCIDA CONTROL: Alternative pest control where the same specie is used for its control previous sterilization; for example: the Mediterranean fly.
BACILLUS: a cane form bacteria.
BACTERIA: Microscopic microorganism that can provoke plant illness.
BACTERIOSIS: Disease provoked by bacterium.
BACULOVIRUS: Agent of natural biologic control of grain moth larvae.
BAIT: Any material used to attract a plague towards a trap, to obtain samples or to eliminate it.
BAND APPLICATIONS: Application of the plant protection product in only one area of the crop; for example: in row treatment, to the treetops or in between rows.
BIENNIAL: Plant that completes its life cycle in two years. It generally germinates, grows and stores nutrients in the first year, blooms and fructifies the next year.

BIODEGRADATION: Process by which the microorganisms use a substance as an energy fountain destroying it, it is generally applied to biological processes in the soil, water and to residual water.

BIOTIC: Natural factor related to living creatures, for example: the depredation, the parasitism, etc.

BIOLOGICAL DIVERSITY: Variety of organisms.

CALCAREOUS: Calcareous water, water that contains lime.

CALIBRATION: Determination of the application quantity of an equipment.

CANKER: Necrotic injury, frequently deep produced in stem and branches.

CATHARTIC: mechanical or chemical drug action, that when it is ingested speeds up the expulsion of the intestinal contents.

CHLOROSIS: When the green tissue of a plant becomes yellow.

COADJUTOR: Any substance that is included in the formulation of a plant protection product to improve its efficiency; for example: moisturizers, adherents, emulsions, etcetera.

COLINESTERASA: Enzyme that is necessary in the insects and human beings for the normal nervous function, it is inhibited or damaged by organophosphorus insecticides and carbamates.

COLOID: Dispersed particles in a fluid, in sizes between 0,1 y 0,2 upbringing a suspension called colloidal.

COMMERCIAL BRAND: Name under which the manufacturer sells its plant protection products, it is not always the same as the common chemical name, but sometimes it is similar.

COMPATIBLES: Plant protection products that have the characteristic or predisposition to mix one with the other.

COMPETITION: An organism ability to use or metabolise a substratum more efficient than other.

CONCENTRATE: The quantity of an active ingredient in a determined volume or weight of a formulation or mixture.

CONTROLLED DROP APPLICATION: The application of plant protection products with a machine, that often, has a revolving disc and with which little drops of uniform size are obtained.

CROP: A cultivated variety.

CORROSIVE POISON: Poison that would provoke heat (burns) in the skin, mouth and stomach.

COTYLEDON: The first leaves that appear when a seed germinates.

COVERAGE: The objective area covered by a pesticide, expressed in percentage.

COVER CROPS: Crops that are planted to oppose the effects of an eolic and hydric erosion, keeping the soils humidity and fertility, and the biodiversity.

CULTURAL CONTROL: Alternative of pest control through an expert combination of agronomic practices, such as tillage, sowing, irrigation, healthiness crop rotation and the selection of healthy and resistant varieties.

CUTICULE: External film that recovers a plant or animal. CURLY: Symptom that makes reference to the curling leaves, for example in the case of sickness produced by virus.

CYST: Excessive growth produced in plants as a result of a pathogenic infection. Tumour or growth in leaves, stem and roots.

DANGER: In relation to plant protection products it is the combination of the product toxicity and its exposition. Without toxicity or exposition there cannot be danger.

DEFOLIANT: Pesticide used to eliminate the plants leaves.
DEGRADATION: Process by which a plant protection product is reduced to a less complex form.

DEPOSIT: Quantity of a plant protection product that reaches the objective.

DEPREDATOR: Animal that in order to survive hunts another called victim.

DESICCANT: Pesticide used to dry and destroy the foliage of a plant, generally with the purpose to accelerate the dryness or the ripening planning the recollection.

DETERGENT: Liquid normally used as a substance to clean. Some of these products can also be used as moisturizers to improve the adherence covering capacity of a plant protection product.

DIAGNOSIS: Conjunction of signs and symptoms used to fix the characteristics of a phytosanitary problem.

DICOTYLEDON: It is said of plants that produces two cotyledons (embryos leaves) for example: a wide leave weed.

DILUTOR: Not live material used to dilute a concentrated material.

DL 50: Is the lethal dosage necessary to destroy the 50% of the essay population when it is administered as a unique dosage through the mouth (oral via). The dosage is generally expressed as the weight of a chemical substance, in milligrams related with the weight unit of the rehearsed species (kilograms).

DIRECT PLANTING: Planting of a crop in the soil without tillage or preparation from the previous harvest.

DISINFECT: To destroy microorganisms that are over or in a tissue.

DISINFECTANT: A substance that kills microorganisms that are over or in a tissue.

DISPERSENT: An additive that helps the dew little drops to cover the surface of a vegetable more uniformly.

DISSEMINATION: The inoculation motion form one place to another.

DIVIDED OR FRACTIONED APPLICATION: Treatment in which the total dosage of plant protection products is divided and applied in different opportunities.

DOSE: Quantity, expressed in weight or volume of any material.

DOSE: Quantity, expressed in material quantity per weight unit, length, area or volume.

DRAIN: Refers to a liquid or mixture that free flow in a surface.

DRIFTING: Dew deviation of a spraying towards an undesired place.

ECLOTION: It is said of the birth of an animal through an egg.

ECONOMIC DAMAGE: Damage that results from the harvest loss.

ECONOMIC THRESHOLD: Occurs when the density of a plague population gets closer to the economic damage level and the control measures should initiate.

ECTOPARASITE: Parasite that lives in the exterior of a guest.

EFFECTIVE BAND APPLICATION: Length of area reached by the sprayed particles.

EFFICIENCY: The capacity to produce a desired effect.

EMETIC: Substance that provokes vomits and that can be use in first aid for certain kinds of intoxication with plant protection products.

EMULSIFICANT: Chemical substance that helps a liquid to form small drops, which remain suspended in other liquids; for example one used to make a stable mixture of two liquids, such as the oil and the water, which normally would not mix.

EMULSION: A mix in which one liquid disperses in small drops in another fluid.

EMULSIONABLE CONCENTRATE: Liquid formulation of a plant protection product, compound by an active ingredient, a solvent and an emulsifier, that is mixed with water to make an emulsion.
ENVIRONMENTALLY ACCEPTABLE: When the undesired effects of the use of any technology presents minimum risks for the environment.

ENVIRONMENTAL DYNAMIC: It makes reference to the way how chemical, physical and biologic processes degrade or makes powerful a chemical compound when being free in the environment.

EPA: Government organisation of the United States of Americas that makes that the rules over plant protection products are executed.

ERRADICATION: Remove, eliminate or total destruction of a pest organism of an area or of an individual plant.

EXOTIC: Not native, from another country.

EXTERNAL DRIFT: Particle movement out of the intentional treated area.

EXTERNAL PARASITE: Parasite that lives in the outside of an innkeeper.

EXTERNAL SKELETON: Anthropods external skeleton.

FIRST AID: Emergency treatment given to a patient before being assisted by a doctor.

FLOATING PARTICLE: Particle suspended in the air that does not deposit because of insufficient energy.

FLUIDITY: Denotes that a plant protection product can slip and displace freely.

FLOW: The material quantity that displaces per unit of time.

FOOD CHAIN OR TROPHIC CHAIN: A series of living organisms, one feeds another, at least partially, of whom precedes, for example: the rabbit eats herbs, and the rabbit is consumed by a wolf, etcetera.

FORMULATION: Preparation of the active ingredient in such a way that the user can store and apply it.

FROG LEG: Symptom that presents ill plants that is characterized by the proliferation of branches and roots.

FUMIGATION: Application of a plant protection product in a gaseous way into a crop or for an environmental treatment.

FUNGICIDE: A substance that kills fungus.

FUNGISTATIC: A substance or a fungicide concentration, that inhibits the growth of a fungus but does not kill it.

FUNGUS: A thallophyte plant without chlorophyll and its body structure is filiform and branched. The fungus have cell walls and nucleus. Its reproduction can be sexual or asexual.

HABITAT: Conjunction of environmental factors where lives, in a natural way, a determined animal or vegetable specie.

HYDROPHOBIC: Rejects the water.

HYDROSCOPIC: Absorbs humidity easily.

HOMOGENEITY: Action or effect of homogenize, transform in homogeneous a compound or compound mixture.

ILLNESS: A dynamic interaction between an organism, an innkeeper and the environment, that causes in the organism abnormal physical changes, often morphological or neurological.

IMMUNE: No susceptible to a disease or poison.

INCOMPATIBLE: That cannot be mixed.

INERT INGREDIENT: Any formulation substance that has no pesticide action.

INFLAMMABLE: easy to set on fire.

INGEST: Eat or swallow.

INHALE: Aspire deeply.

INOCULATION: Pathogenic transportation process to the plant and to its organs.

INOCULUM: Structures, generally spores, mycelium, sclerotia, bacterial cells, viral particles, etcetera, used to inoculate.
INSPECTION: Exam and recognition of a thing, for example: a crop to identify the present problems.
INTERCELL: Between cells.
INTERNAL DRIFT: Particle movement distributed in the objective area.
INTERNAL PARASITE: Parasite that lives in the interior of a guest.
INTERSOWING: Sowing crop in an intercalated way.
INTOXICATION: State produced by the introduction or by the accumulation of toxic substances in the organism.
INVITRO: Culture outside of the innkeeper.
INVIVO: Culture inside of the innkeeper.
LARVA: The second step in the life cycle of an insect that later would convert in pupa or chrysalis.
LEACHING or LIXIVIATION: Dragging process by water rain of soluble materials or colloidal of soil superior horizons or deeper horizons.
LIQUEFIABLE: That it has fluidity.
LOSS: Quantity of applied material that is not retained by the objective, generally expressed in percentage.
LYSIS: Dissolution of a cell.
MAXIMUM RESIDUAL LIMIT: The maximum concentration (in milligrams by kilogram or in parts by million) of residuals from plant protection products that is legally permitted in or over a nourishment, agricultural product or animal food.
METABOLISM: Collection of chemical reactions that the swallowed or absorbed substances are submitted to, by the living creatures until they provide energy or until they become part of their own structural architecture.
METAMORPHOSIS: Change in the form or structure of an insect during its life cycle, as: egg, larva, pupa and adult; or egg, pupa and adult.
MILDEW: Illness in which the pathogenic can be seen as a growing on the innkeepers’ surface.
MICROPLASMA: Microorganism that can provoke plant diseases.
MICROENCAPSULED: Formulation of a product for plant protection that is presented in micro-capsules for the security of the user and the environment.
MIST: Application of a spray that occupies an air volume that reduces the visibility.
MITIGATION: Soften, diminish or moderate the effects of a thing, for example the mitigation areas in an agricultural system pretend to reduce the environment contamination risks.
MIXTURE: a liquid, in the exact concentration to be applied, is the result of the dilution or a concentrated formulation.
MOISTURIZING: Helps wetting in a better way the surface of the treated vegetables with the spraying dew.
MOLLUSKICIDE: Product for the plant protection that is used for the control of snails and slugs.
MOLTING: Process through which an insect changes the skin and the form.
MUMMIFY: A dried and wrinkled organism as a result of a fungus illness.
MUTATION: Spontaneous appearance of a new characteristic in an individual as a result of an accidental change in its genes or chromosomes.
MONOCOTYLEDON: It is said of plants that only produce one cotyledon.
MOSAIC: Symptom of a disease provoked in the plants by a virus.
MYCELLIUM: Mass of hyphas that are the fungus body.
NECROSIS: The death of the vegetal tissue.
NEMATODE: Organism of round body that lives in the soil and could parasite the plants.
NUTGALL: Excrecence, tumour or swelling of plant leaves, stem and roots.
OBJECTIVE: Surface or plant intended to be applied with a plant protection product.

OBJECTIVE PLAGUE: The plague that is the specific objective of plant protection products or other control method.

OVICIDAL: Product of plant protection used to destroy the insect eggs and mite.

PARASITE: Any organism that lives and feeds of a plant, animal or insect causing damage or death.

PARASITOID: Organism that lives and feeds of a guest until the life cycle completes causing death.

PART PER MILLION (ppm): Expressed as weight or volume. Term frequently used when refers to residuals of plant protection products and its tolerance. An ppm is equal to 1 mg of a substance in a litre of water.

PATHOGENIC: An organism or biological agent capable to cause disease.

PERENNIAL: A plant that normally lives more than two years.

PERSISTENCE: The property of a plant protection product to be active by a determined period of time.

PEST OBJECTIVE: The pest that is the objective of a plant protection product or of another control method.

PHENOLOGY: Study of the influence of climatic changes in the vital phenomenon for example: crop development steps.

PHEROMONES: Substances that attract, stimulate or prevents certain insect activities; for example: the mate.

PHYTOSANITARY: Plants health.

PHLOEM: System of living cells enlarged interconnected, in the plants, that carries the photosynthesis products from the leaves to the growing tissues.

PHOTOLYSIS: Denotes that a plant protection product can be degraded by the light action.

PHOTOSYNTHESIS: Production of sugar in a plant, in presence of light and chlorophyll.

PLANT BREEDING: Biological science that studies the plants variability and inheritance.

PLANT PATHOGEN: Infectious agent that causes plant diseases.

PLANT TOXICITY: Denotes that a plant protection products is toxic for plants.

POLLINIZATION: Union process of the pollen and the plant ovule. The insects and the wind may favour it.

POPULATION DYNAMIC: It makes reference to the regulation of a population (growth or no growth) for the intrinsic or extrinsic environmental resistance.

PRECIPITATION: Another name for rain.

PRE-HARVEST INTERVAL: The waiting period that should be respected between the last application of plant protection product and the crop recollection, appears in the pamphlet and the label.

PROGRESSIVE DEATH: Death of branches or small branches. It starts from the small branches and goes in progress to the stem or stump.

PROPHYLACTIC: A chemical substance or treatment, used to prevent a pathogen invades an organism causing a disease, different to one curative.

PROPHYLAXIS: Group of measures used to prevent an organism illness. Measures used to avoid illness.

PUPA: The inactive life step of an insect between larva and adult, in certain insects that experiment complete metamorphosis.

PUPA: The immature step of an insect such as the locust, grasshopper, bug that do not experiment a complete metamorphosis.

RANDOM SAMPLE: The more common sample used to determine the number and the pest damage and realized by random.
RECUPERATION: Quantity of material retained by the objective, generally expressed in percentages.

RE-ENTRY PERIOD: Period of time between the application of a plant protection product and the re-entry to the treated area.

REPOET: Process in which insect changes skin and form.

RESISTANCY:
1. A characteristic that exists or is developed by natural selection, that makes a plague survive to the toxic effects of a pesticide.
2. A complex property of plants and animals that allows them to resist partially or completely the pathogenic effects of an infection.

RISK: The probability that a substance might be dangerous. It includes three components: The toxicity, the exposition and the probability of exposition.

RHIZOME: Underground trailing stem, that is used by the plants to extend or multiply.

RODENTICIDE: Plant protection product used to combat rats, mice and other rodents.

ROTATION: The practice to produce crops in the same parcel, in a regular sequence to maintain the fertility and avoids plagues such as weeds, insects, or soil diseases, reach damaging levels of population.

RUST: Illness that gives the plant a rusty appearance and is caused by fungus.

SAMPLE: Action of obtaining samples of organisms that are damaging the plants.

SAPROPHAGUS: Organisms that feed from organic materials in decomposition or putrefaction.

SATURATED: That is in its maximum capacity, for example: a soil saturated of water, permits the drainage of the same.

SATURATION POINT: Point of more liquid retention in the vegetal surface.

SCATTERED APPLICATION: Term that is used to describe the complete scattering, (distribution) of a granule, powder or mixture over a parcel, total aerial application (blanket application).

SCROTUM: A bag formed by a little skin portion and its purpose is to keep and protect the testicles.

SELECT: Elimination of undesired plants in the crop, is often hand made, and sometimes can be used a plant protection product.

SOCIALEY ACCEPTABLE: Technology accepted by society through the actual knowledge.

SOIL STERILIZATION: Pesticide applied to the soil (generally injected or incorporated) to obtain a general soil plague control, whether they are insects, diseases or weeds.

SOLUTION: Mixture of a solid, liquid or gas, diluted in a liquid.

SOLVENT: Liquid, as water, paraffin or oil, that dissolves a plant protection product and forms a solution.

SPECIES: A group of plants or animals, with similar characteristics and common name that propagates according to kind.

SPORE: Small propagation unit that works as a seed, but it is different from the seed that does not have the preformed embryo.

STRATEGY: Art of coordinating all kind of actions or alternatives for the solution of a phytosanitary problem.

STYLET: Large, thin and hollow structure of the nematode and some insects that have an alimentary function.

SUSCEPTIBLE: Denotes that the plant or insect could be easily controlled by a plant protection product, strictly following the usage indications.

SUSPENSION: Solid particles finely divided, distributed integrally in a liquid or gas.
SYMBIOSIS: The living together of two or more different organisms, everyone giving or taking from the other; for example: The bacteria of the radical nodule with the legumes plants.
SYNERGISM: Complementary action of two or more plant protection products, by which the combined effect is higher than the addition of the effects of each one separately.
SYSTEMIC: It refers to plant protection products that can translocate through the plants.
SYSTEMIA: Denotes the Systemic action.
THERMO MIST: Mist by thermo energy.
TO CULL: Elimination of undesired plants in a crop, it is often handmade, but sometimes a plant protection product can be used.
TO INHALE: To aspire deeply.
TOLERANCE: The ability of a plant to bear an illness, the inherent ability to be severely attacked by an illness without significant reduce of its yield.
TO WRING OUT: It refers to the liquid or liquid mixture that runs free over a surface.
TOTAL APPLICATION BAND: Length of the reached area treated by the sprayed particles.
TOXICITY: The capacity of a substance to produce damages in human beings and environment.
TOXIN: Poison elaborated by an organism.
TRAP CROP: Crop area that is planted before the commercial plantation with the purpose of controlling the pest in a reduced and localized area.
TRANSLOCATION: Denotes that a plant protection product can move inside the plant.
ULTRA LOW VOLUME: The application of plant protection products not diluted, in dosages of less than 5 litres per hectare.
VASCULAR SYSTEM: The phloem system of tubular form and the xylem cells in a plant, from their entrances or synthesis sites, to their usage and storage sites.
VARIETY: Taxonomical group inferior to a specie. More precisely cultivated variety.
VECTOR: A porter as an insect, that transmits a pathogen from a sick plant or animal towards a healthy one.
VEHICLE: Inert ingredient in a formulation of a plant protection product, over or in which, the active ingredient is absorbed; for example: kaolin for powders.
VESSEL SYSTEM: The phloem tubular form and the xylem cells in a plant, from the entrance or synthesis, and the use and storage places.
VIRULENCE: Degree of an infectious power of a pathogen.
VIRUS: Microscopic obligate parasite that contains ARN o AND, never both. VOLATILITY: The ability to vaporize rapidly.
WETABLE POWDER: Formulation of a plant protection product, compound by an active ingredient mixed with a fine powder and a moisturizing agent, that mixes easily with water and makes a spray suspension.
WHITENASH: Mixture of a liquid and a wet powder, with creamy consistency.
XYLEM: In the vegetables, the channel systems more or less continuous, formed by inert joined cells, that transport water and insoluble minerals from the roots to the leaves.