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Information

Safe use of pesticides

Plant pest & disease control products

The object of these notes is to give those requiring a good grounding in the safety aspects of pesticides, together with a background knowledge of the right selection of products, based on sound agrochemical understanding. These notes are designed to help in providing a greater understanding of the whole subject of crop protection substances.

INTRODUCTION

What are chemicals? Pesticides are defined as.....

Chemical substances and certain micro-organisms (bacteria, fungi, viruses and mycoplasmas) prepared or used to destroy pests. Pests include creatures, plants and other organisms and therefore the term pesticides encompass products such as herbicides and fungicides.

Pesticides cover such items as soft soap and creosote, which are two common products.

Of the 500-600 chemicals used in modern agriculture and horticulture only around 50 are categorised as poisons. The remaining ones are not necessarily harmless, but can be regarded as less toxic to humans when used in the right way, at the right rates and in the right conditions.

Protecting the operator

Various protective clothing is needed according to the type of product being used and the method of application. Particular care should be taken to avoid personal contamination by careful working practices and by using the most appropriate protective clothing. The full details are shown on the wall chart.

<i>Respirator</i>	=	<i>A</i>	<i>Head Protection</i>	=	<i>E</i>	<i>Sleeves over gauntlet gloves</i>	=	<i>I</i>
<i>Face-shield</i>	=	<i>B</i>	<i>Rubber Boots</i>	=	<i>F</i>	<i>Rubber Coat</i>	=	<i>J</i>
<i>Goggles</i>	=	<i>C</i>	<i>Rubber Gloves</i>	=	<i>G</i>	<i>Rubber Apron</i>	=	<i>K</i>
<i>Hood</i>	=	<i>D</i>	<i>Rubber gauntlet gloves</i>	=	<i>H</i>	<i>Overall</i>	=	<i>L</i>

All protective clothing should be cleaned and inspected after use and maintained in good order, replacing worn gloves equipment and clothing as soon as it becomes necessary. Gloves should be washed thoroughly inside and out after each use.

SAFETY WHILST SPRAYING

Pre-spraying checks

1. Identify the problem
2. Select the product
3. Check the weather
4. Check that all equipment to be used is serviceable
5. Make sure equipment is calibrated
6. Ensure that the operation is timed to minimise inconvenience

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Hygiene

1. Always wash hands before eating or drinking
2. Never smoke whilst spraying
3. Never eat whilst spraying

General rules

Plan ahead and work methodically
Never pour chemicals back into the bulk container
Never climb with a measuring jug in your hand
Take care of large containers and the "glug factor"
Spillages should be dealt with immediately
Never pour chemicals into other containers unless well marked
Never leave chemicals unattended
Only use chemicals in accordance with label

Action on the day of spraying if outside

Listen to the weather forecast
Check for wind and rain and sun
Wear correct clothing
Check: boom height boom bounce spray pressure
forward speed engine speed nozzle performance
spray drift swath matching level of liquid in tank
Notify beekeepers and neighbours
Avoid rivers, ponds and streams
Write up records
Dispose of empty cans by burying them or putting in a skip for burying by others
Wash out the sprayer before using any other product

Action on the day of spraying if under protection

Listen to the weather forecast
Check for frost and sun
Wear correct clothing
Check: items of clothing and food are not in spray area
people are advised of spraying and clear of spray area
supervisor knows you are spraying
sprayer calibrated right and walking speed even
nozzle performance
spray drift
swath matching
level of liquid in tank
Avoid water tanks
Write up records and put up notices of safety days
Dispose of empty cans by burying them or putting in a skip for burying by others
Wash out the sprayer before using any other product

Application of pesticides

Very few pesticides can be applied by hand, mainly because of the large areas to be treated, so they are nearly always applied by some mechanical means. Pesticide formulations are made up in several forms:

Liquid suspension concentrate *Granules* *Wettable powders*
Smokes & fogs *Dusts or powders*

1) Liquid formulations The majority of pesticides are formulated as liquids and are applied to the crop as a liquid, after first being mixed with a carrier, which is usually water. An emulsifiable concentrate is a solution of the active ingredient in oil or other suitable solvent to which emulsifying agents are added that enable the solution to be added to water and a stable liquid be formed. Some pesticides, particularly soil acting herbicides, do not dissolve well in organic solvents so these are finely ground and made into suspensions in water with various additives to stabilise them and prevent them coming out of suspension.

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These are called suspension concentrates, and are similar to water based paints. Wettable powders are designed to be mixed with water and can therefore be applied with a normal sprayer. It is important that the mixture is well agitated in the tank to prevent settling.

2) Dusts or powders Very few products are available as dusts today, mainly because of the dangers of drift to the operator and the problems of application.

3) Granules Quite a few pesticides have been formulated as granules today. They have advantages over dusts and powders and they do not have to be mixed with water. The basic material is fullers earth, chalk or brick dust with a granule size graded. The chemical is partially absorbed by the granule and partially stuck on with cellulose stickers. The rate of release of the active ingredient can be altered by the formulation. The presence of a granule does not mean the product is still active. This point is often overlooked when using this method.

4) Smokes & fogs Applying chemicals to restricted areas can be done effectively by smokes. Chemicals are incorporated into a firework mixture, which heats up and vaporises it into the space. Fogs are produced by incorporating the pesticide into a petrol flame heated air stream, which vaporises the pesticide and allows a fog containing the product to drift throughout the house like a smoke.

Application timing and details

Assuming the correct pesticide has been chosen for the task and a suitable application method has been chosen, it is vitally important that attention is paid to the timing of the application in respect to the pest or disease life cycle and to ambient conditions. Efficient as they are, no pesticide will work well in the wrong conditions. Knowledge of how a pesticide works will assist in selecting the correct timing period, as will knowledge of the pest or disease.

Soil or compost condition

Some products need a fine, moist surface to work. Wet composts can drive away the very pest you want to attack.

Stage of growth of plant

Spraying a systemic fungicide when a plant has no leaves is a waste of time.

Weather conditions

Spraying in hot conditions can cause scorch, and rain after a fungicide application can destroy any good you have just done. Watering a crop after spraying can also wash off the product. Try to wait 4 - 5 hours after spraying before watering. Translocated herbicides, such as Roundup, need time to work. The addition of fertiliser can assist the speed of the herbicide.

Pre-harvest interval

Make sure the interval between the spraying and safe harvesting is not reduced. This can apply to disbudding some crops after spraying too. New legislation on residues is coming soon and will affect the levels permitted by law. Some food processors insist on taint levels. Check what these are and observe them.

Succeeding crops

Some pesticides last for quite some time and can still be active after the crop has been harvested. Make sure the pesticide will not harm the following crop if it is still active. This can include herbicides in straw and late Roundup sprays on cereals.

THE PRODUCTS

Major classifications

Herbicides	-	weed control
Insecticides	-	insect control
Fungicides	-	fungal control
Molluscicides	-	slug and snail control
Nematicides	-	eelworm control
Growth regulators	-	growth control
Seed treatments	-	prevention of insect or disease

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| Acaricides | - | mite control |
| Ovicides | - | insect egg control |

Herbicides

Application methods

- 1) **Soil applied.** The herbicide is applied to the soil surface. In the main the target part of the weed is a young emerging seedling, but in some cases it is the root of the weed that absorbs the herbicide.
- 2) **Foliage applied.** The herbicide is applied to the foliage of the weed and is absorbed through the stomata. Once in the weed one of several modes of action can bring about death.

Mode of action

- 1) **Photosynthesis inhibitor.** After entry into the plant the process of photosynthesis is prevented. In some cases a toxic product is produced instead of food and in others the production of sugars and starches within it are interrupted.
- 2) **Mytosis inhibitors.** Once in the plant the material is transported to the growing tips where it upsets the normal extension growth process. In some products this can be in the roots only and in some shoots only and in others both.
- 3) **Growth regulators.** Having entered the plant the cell-division process is modified causing the familiar distorted foliage effect seen with some hormone herbicides.

Formulation types

- 1) **Granular.** One effective way of overcoming leaf scorch of the crop and yet achieve application of the herbicide to the soil is by impregnating a carrier granule with the herbicide. Soil moisture rain and irrigation can cause spread of the herbicide out into the surrounding soil.
- 2) **Emulsifiable concentrate.** Some products particularly when they have a vapour action are dissolved in an oil-based solvent. This ensures the product arrives at the target before it vaporises, and can be safely mixed with water as a spraying medium.
- 3) **Wettable powder.** If the product is difficult to get to stick on a leaf, or needs to be persistent over a long period, then impregnating a fine powder with the herbicide and spraying it onto the soil with a water mix is being chosen by a growing number chemical companies is a growing formulation type. The powder controls the release over a period of time, or prevents deep penetration of the herbicide if it is a surface acting product.

Modes of retention

- 1) **Residual** This group of herbicides as their name suggests adhere to the soil colloid by a chemical bonding. The action of various soil and organic processes on it allow the product to remain in a narrow band near the soil surface. The period of residuality can vary from product to product.
- 2) **Pre-emergent** Some herbicides are applied before the crop comes through. This allows the crop to get off to a good start.
- 3) **Soil incorporated** In this group the soil is sprayed and harrowed or rotovated before the crop is planted. This provides a band of herbicide above the rooting depth of a transplant. The use of this system for some seed sown crops is not recommended unless they are drilled well below the herbicide layer.
- 4) **Translocated** Some herbicides after sprayed onto the foliage of the weed are absorbed into the food and water system and moved around in the plant. This ensures that the target zone of the growing tips both root and shoot are attacked from within. This is most useful on weeds that have long, interconnected root and shoot systems. If only one part of the plant is sprayed you will kill the whole thing wherever it is connected.
- 5) **Contact** This group of herbicides works by killing wherever it touches. It is only if the product has touched the weed that it will kill it. Some of this group are very sensitive to soil, and even a muddy or dust covered leaf is sufficient to prevent good action of the herbicide. This group can also affect the green bark of young trees and woody herbaceous.

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Insecticides

- 1) Contact** As the name implies this type of insecticide kills by contact with the insect, and must be applied in such a way and at such a time as to ensure that the insect cannot avoid being in contact with the insecticide, either by being sprayed or by walking through the residual spray deposit.
- 2) Systemic** Systemic insecticides are absorbed by growing plants, the chemical then travels upwards through the plant. Any insect, which then feeds on the plant with a sucking action, will take in some of the insecticide.
- 3) Stomach poison** These insecticides kill because the insect eats some of the chemical.
- 4) Fumigant** The fumes or vapour given off by the insecticide usually gain entrance via the breathing mechanism of the insect, and frequently affect the central nervous system.
- 5) Pheromones** A scent identical to that given off by female insects at the time of mating attracts males, where they are stuck onto large flypaper type materials.
- 6) Ovicides** The eggs of an insect are one part of the life cycle that can be difficult to control. This group are aimed the egg control. They are particularly effective against mites.
- 7) Acaricides** Mites are stronger in many aspects to other insects and feed indifferent ways. A specific group of insecticides will control mites. Most are only effective against young or adult mites and not eggs. Mites have an ability to quickly defend themselves against a chemical, so using several different ones in a season is important.
- 8) Nematicides** Eelworms affect more crops than we realise and may be responsible for more problems than we are currently aware of. They are controlled in the main by fumigation under ground. As they live within the plant tissue some translocated insecticides are effective against them.
- 9) Molluscicides** Molluscicides are chemicals to control slugs and snails and usually work by means of stomach ingestion. Contact action is difficult as slugs and snails spend much of their life under ground so bait is used to attract them. The most familiar products cause the slug or snail to stop producing the slime on which they slide, and they eventually dehydrate.

Fungicides

This group of pesticides is used to control or prevent the various fungal diseases infecting the crops. A fungus is spread by means of spores, which upon contact with a suitable plant take hold by means of small roots called hyphae. These penetrate the plant cells and produce a mat of mycelium within the plant. The life cycle of a fungus is often complex and it can be spread by a variety of means - wind, rain, animals or soil.

- 1) Contact** This group of fungicides control the fungi on the plant by direct contact. They are applied directly to the leaf. Some are persistent and remain on the leaf for several days; others are ineffective after a day. Most are aimed at the fungal spores that alight on a leaf and some have the ability to destroy the fungi before it sporulates.
- 2) Systemic** These are fungicides that are taken into the plant and distributed through the plant with the sap. Any fungus penetrating the cell wall comes into contact with it and is controlled.
- 3) Trans-laminar** Some fungi live on the underside of the leaf and are difficult to attack. Translaminar fungicides penetrate the cuticle of a leaf and pass through to the other side.
- 4) Fungistat** Some fungicides do not kill the disease but reduce its activities or suppress it. These are called fungistats.

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