Section 5

Pesticide Formulations

What is a Formulation?

Pesticides are sold in three main types of formulations (solid, liquid and gas). A single pesticide may be sold in more than one formulation. A formulation is developed to make the product safer, more effective and more convenient to use.

A **formulation** is a mixture of chemicals (formulants). A pesticide formulation contains:

- **active ingredients (a.i.),** one or more chemicals that control the pest, plus
- **inert ingredients**, other chemicals which have no pesticide action.

An inert ingredient is added to the formulation to make it suitable for use. Examples include talc in a dust formulation or petroleum distillate in an emulsifiable concentrate formulation. Other inert ingredients such as solvents, wetting agents, extenders or emulsifiers may also be needed. Although they have no pesticide action, inert ingredients may be toxic to the applicator.

Some products are ready to use and require no further mixing. However, most products applied in the liquid form must be diluted in water or oil before use.

The type of formulation depends on several factors:

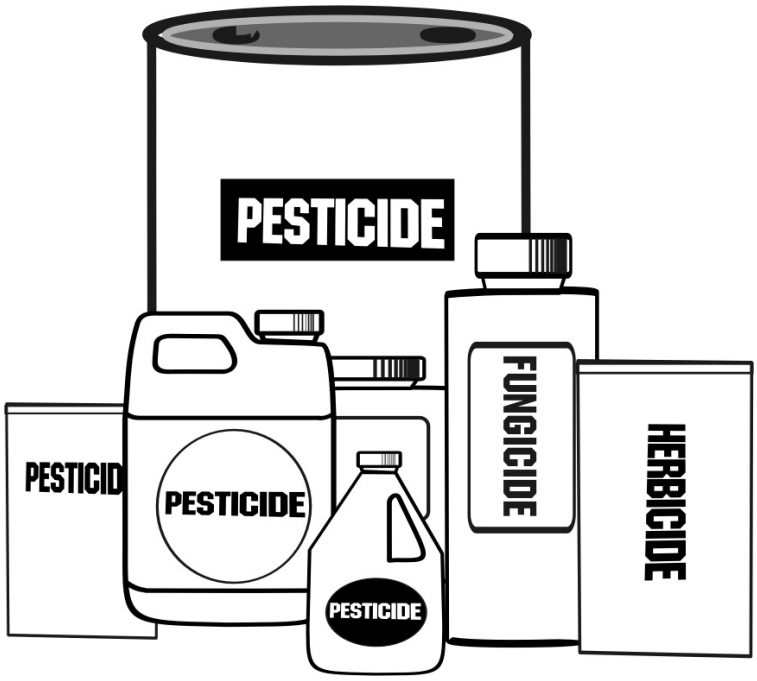
- chemistry of the active ingredient
- toxicology of the active ingredient
- how effective the product is against the pest
- the effect of the product on the plant, animal or surface
- the effect of the product on the environment
- how the product will be applied and the equipment needed
- the application rate.

Formulation Types

Formulation types can be divided into solids, liquids and gases.

Solids	Liquids	Gases
Dusts or Powders, Granules, Pellets, Tablets, Particulates, Dry Flowables	Suspensions (Flowables), Solutions, Emulsifiable Concentrates	Fumigants sold as liquids or solids

The charts on the following two pages show different formulation types as well as the advantages and disadvantages of each type.



Summary of Formulation Types

Name	Description	Advantages	Disadvantages	Typical Use
Solids				
Dry Flowable Pesticides	A wettable powder which is formulated into small pellets or granules.	Much less dusty than WP formulations and easier to handle	Requires agitation in spray tank	General Use
Dust or Powder	A finely ground dry material of a low concentration (a.i.) plus inert ingredients such as talc. No dilution needed before use.	Ready to use	Dusty. Drifts. Can easily be seen on surface	Spot treatment Animal powder
Ear Tag/ Vapour Strips	**Slow-release generator** - solid base material and a volatile liquid or solid toxicant(s). Slowly emits as a vapour, or releases on contact with skin (ear tag).	Ready to Use		Animal ear tags Fly control
Granular	A mix of dry, large free-flowing particles usually with a low concentration of a.i.	No mixing required. Ready to use. Drift minimal	Some dust. Requires special application equipment	Soil treatment for insect or vegetation control
Impregnated Fertilizer	Granular fertilizer containing a low amount of herbicide	One step application. Low a.i. concentration. Not dusty	Could clog equipment	Agricultural soil application
Particulate or Bait	Mixture of large particles not recognized as a pellet or granular formulation. Mixed with edible material.	Easy to spot treat	Pets and children may eat it	Bait for insects or rodents
Pellet	Preformed mixture of a.i. and inerts to form small pieces	As above	As above	Baits to control rodents, slugs
Seed Treatment	A finely ground dry material containing a coloured dye	Added colour makes it easy to tell treated seed from untreated.	Care must be taken with dye	Seed treatment
Soluble Powder or Granules	A dry material similar to dust or granules above except it is soluble in water	Containers empty easily. No liquid spills	Dusty	General Use
Tablet	A preformed “tablet” composed of inerts and a.i.	Easy to measure and use	Accessible to pets and children	Fumigant
Wettable Powder (W.P.)	a.i. added to a powder (clay, talc) contains a wetting and dispersing agent. Forms a suspension in water.	Containers empty easily. No liquid spills	Dusty. Requires agitation to remain in suspension	General Use

Summary of Formulation Types (continued)

Name	Description	Advantages	Disadvantages	Typical Use
Liquids				
Aerosol	A liquid with one or more solvents. Ready to use in pressurized containers	No mixing required - low concentration of a.i.	Pressurized containers are hazardous if punctured or heated	Flying insect control
Emulsifiable Concentrate (EC)	A clear solution with emulsifiers to be diluted in water. Final spray solution has a milky look	A high concentration of a.i. in each container. Buy less bulk	Possibly flammable	General Use
Gel	High assay semi liquid, emulsifiable concentrate	Used with Water Soluble Packaging	Cannot measure "undividable" amounts	Agriculture Uses
Micro-encapsulated Suspension	A suspension with a.i. in micro-capsules giving a slow release of a.i.	See comments on EC's. Increases the residue of a.i. Reduces hazard to operator.	May be expensive	Insecticides
Suspension or Flowable	A cloudy liquid composed of solid particles of a.i. (finely ground) in a liquid. Must be diluted	See comments on EC's.	Active ingredient may settle out of formulation.	General use
True Liquid/Solution	a.i. is in solution, usually water, and when mixed with water remains clear.	See comments on EC's. Requires little agitation when added to water in spray tank	Possibly corrosive	General Use
Ultra-low Volume (ULV) Concentrates	Solution of a.i. designed to be used undiluted only in ULV equipment. Very high concentration of a.i.	Use without mixing	Concentration of a.i. during application makes them hazardous. Special equipment required.	Insecticide sprays normally inside structures, also in forestry
Gases				
Fumigants	Volatile liquids or solids packaged for release as a gas	Toxic to many forms of the pest at one time. Penetrates cracks and crevices	Area to be fumigated must be well sealed. Highly toxic.	Structures. Bulk containers (eg. ships).
Organisms				
Live Organisms	a life form capable of reproduction, for example mites	specific to the pest	must be kept alive, must be contained	greenhouse

Common Abbreviations for Formulations

Abbreviations are often used after the trade name on the pesticide label to indicate the type of formulation:

D	Dust
DF	Dry Flowable
EC	Emulsifiable Concentrate
F	Flowable
GR	Granular
L	Liquid
LO	Live Organism
P	Pellet
S	Solution
Sc	Sprayable Concentrate
SG	Soluble Granule
SN	Active Solution
SP	Soluble Powder
WDG	Water Dispersible Granule
WG	Wettable Granule
WP	Wettable Powder
WS	Water Soluble Concentrate

Not all companies use the same abbreviations. Check the label if you do not understand the abbreviation. The full name of the formulation must appear on the label.

Adjuvants

The effectiveness of some pesticides may be improved by the addition of adjuvants to the spray mix in the spray tank. However, some products are now formulated with an adjuvant included. You should **not** add any adjuvant to these products. Be sure to read the label.

An **adjuvant** is any substance added to a pesticide spray tank or formulation to improve the effectiveness of the active ingredient. Adjuvants may change the way the product goes on the crop, how long it stays on the plants, or how the product is absorbed. Adjuvants may improve the product by:

- Wetting the surface: the spray may stick to the surface better.
- Increasing/decreasing evaporation: an adjuvant may prevent the spray from drying too fast or help it dry more quickly.
- Increasing absorption into the plant: this is important if the pesticide must enter the plant to be effective.
- Making spray droplets more uniform: this gives more complete coverage of the target surface, placing the pesticide where it can be more effective.

When to Use an Adjuvant

Use adjuvants according to the labels of both the adjuvant and the pesticide product. The **adjuvant label** states which products and formulations you can use it with and how to use it. The **pesticide product label** states the adjuvants that can or must be used with it. Note that some products now include an adjuvant. Nothing should be added to these products.

If you use an adjuvant that is not on the pesticide product's label, the adjuvant may:

- have no effect and be an unnecessary expense
- reduce how effective the product is against the pest
- injure non-targets (crop).

There are many types of adjuvants available. The concentration of the adjuvants and their chemical compositions differ. Crop management advisors and specialists have information on the adjuvants available in your area. Check with them if you have any questions or concerns.

Pesticide Compatibility

Pesticides are considered compatible if they mix well in the spray tank and work effectively together.

Before mixing pesticides together, be sure they are compatible. Do not use pesticides together if you see separation, coagulation, gelling or curdling when they are mixed. These pesticides are not compatible. Check the label for information about compatible products.

Do not use a mixture if it is not identified on the label or recommended in a government publication. Mixing two pesticides which are incompatible is costly and time consuming.

Do not mix more than two pesticide types. Cocktail mixtures of pesticides give poor results and may damage your crop.

Some pesticides should never be mixed. Read the label for specific directions on tank mixing. If no directions are given on any label, don't mix the products. For more information see the next page.

Tank Mixes

Pesticides should only be mixed for spraying when at least one of the product labels gives directions for mixing. If mixing is not specifically recommended, there is **no** guarantee that the tank mix will work. Severe problems could result, including:

- the hazards to you, the applicator, may increase.
- a chemical reaction may occur between the pesticides. The toxicity of the mixture may be reduced or it may increase.
- pest control may be reduced. This is called an **antagonistic** reaction.
- the mixture may leave unacceptable residues on the crop.

When compatible products, recommended for tank mixing, are used together, the effectiveness of the mixture is greater than either of the products alone. This is called a **synergistic** reaction.

Before you mix products, make sure that both products are registered for the intended use. Always check the product labels for the recommended crops, pests, tank mix rates and adjuvants and follow all label directions.

If you mix products that do not have tank mixing directions, you are responsible for what happens. If unsafe conditions result from using the mix, you may be prosecuted under the Pest Control Products Act.

Preparing a Tank Mix

Properly prepare a tank mix to avoid physical incompatibility. Add pesticides to the tank in the order recommended on the label. Compatible pesticides of different formulation types should be added in the following steps:

1. **W**ettables (soluble powders, wettable powders)
2. **A**gitate
3. **L**iquids
4. **E**mulsifiable Concentrates
5. **S**olutions and Surfactants

A quick and easy way to remember the above order is to remember "WALES". Always read the label for complete instructions.

Review Questions

1. Pesticides are sold in many different formulations.

   TRUE FALSE

2. A formulation consists of one or more active ingredients plus inert ingredients.

   TRUE FALSE

3. Formulations can be divided into three common groups. Name these groups.

   1.

   2.

   3.

4. Match the following abbreviations with the type of formulation it stands for:

EC	_____	a.	water dispersible granule
WP	_____	b.	flowable
F	_____	c.	emulsifiable concentrate
GR	_____	d.	soluble powder
WDG	_____	e.	wettable powder
SP	_____	f.	granular
		g.	dry flowable
		h.	water soluble concentrate

5. State one advantage of using an emulsifiable concentrate.

6. State one disadvantage of using a fumigant.

7. What is an adjuvant?

   a) A finely ground dry material containing a dye, usually red
   b) A suspension with the active ingredient (a.i.) in micro-capsules giving a slow release of the a.i.
   c) A mix of dry large, free flowing particles usually with a low concentration of a.i.
   d) A substance added to a pesticide spray tank to improve the effectiveness of the a.i.

8. When compatible pesticides are added to a spray tank and mixed, they tend to separate, coagulate, gel or curd.

   TRUE FALSE

9. The pesticide label contains information about which products are compatible.

   TRUE FALSE