



FORMULATION GUIDE

*THERE ARE ADVANTAGES AND DISADVANTAGES
TO SPECIFIC PESTICIDE FORMULATIONS*

Dr. Michael Pfeiffer

The active ingredient (a.i.) in a pesticide is the actual compound which has an effect on the target pest. Rarely do pesticide formulations contain 100% active ingredient. Typically pesticide formulations contain the a.i. and other ingredients called inert ingredients. The reasons specific inert ingredients are added to the a.i. are many: better coverage, ease of handling, better stability, decreased exposure potential and better dispersion in the solvent are just some of the reasons for adding specific inerts to formulations. Often, a single active ingredient is sold in several types of formulations. Choosing the right formulation may significantly impact on how effectively the target pest is controlled, your liability as a result of the application and effect of the pesticide on non-target organisms. When trying to determine which formulation may be best in a given situation consider:

- Biology and habitat of the pest
- Available application equipment
- Hazards from drift, volatilization and runoff
- Influence of environment on the formulation
- Relative safety to nontargets
- Cost of application
- Cost per unit of active ingredient
- Potential for phytotoxicity to plants
- Potential for pitting, marring or discoloring surfaces

Common Types of Formulations

A - Aerosol

There are two basic types of aerosol formulations. Ready-to-use, self contained units that release the pesticide when the nozzle valve is depressed is one type. These ready to use aerosols are easily stored,

retain their potency over relatively long periods of time and are a convenient way to purchase small amounts of pesticides. Disadvantages of these types of formulations are: they are limited almost exclusively for control of insects, pose inhalation hazards and are often flammable or explosive if used close to flames.

The other type of aerosol formulations are designed to be used with machines that produce a fine mist, fog or smoke. These formulations can be particularly useful in control of pests in enclosed spaces such as greenhouses where the entire space can be filled with particulates laded with pesticides. Disadvantages of these formulations are: specialized equipment is required for application, drift can be significant in open spaces, and exposure via inhalation.

B - Baits

Formulations in which the a.i. is mixed with food or other attractant. Pests are controlled when the bait is eaten. These formulations are ready to use and do not need to be applied over the entire area as the pest comes to the bait. Baits may however be an attractant to nontarget organisms such as children, pets and wildlife. Another potential problem with bait formulations is death of nontarget animals as a result of feeding on pests poisoned by the bait. Odor may be a problem if pests such as rats or mice die in inaccessible areas after consumption of the bait.

D - Dusts

Dry formulations containing the a.i. mixed with or affixed to finely ground materials such as talc, clays, diatomaceous earth, calcium carbonate or organics such as walnut shell. Generally, dusts are ready to use without mixing and do not require sophisticated

equipment for application. Dusts are useful in situations where applying a pesticide in some type of liquid would cause a problem to surfaces or spaces. Dusts do however drift easily off target during and after application, do not stick to surfaces as well as liquids and are difficult to evenly distribute. Due to the small particle size of dust formulations, they can pose hazards from inhalation.

DF or EDF or WDG - Dry Flowable, Extruded Dry Flowable, Water Dispersible Granular

Dry flowable, extruded dry flowable and water dispersible granules are water insoluble formulations that have similar characteristics. The pesticide is attached to very fine dry material such as clay then the individual particles are agglutinated together to form aggregates. When DF, EDF or WDG formulations are placed in water with agitation, the aggregates break apart and the fine particles become suspended. These formulations are less likely than E or EC liquid formulations to cause phytotoxicity to plants, are more easily measured than W or WP formulations and produce less dust during loading and mixing than W or WP formulations. DF, EDF and WDG formulations require constant agitation to keep the material in suspension and may increase wear on equipment due to abrasion. These formulations have the potential to clog strainers and nozzles and leave visible residues.

E or EC - Emulsifiable, Emulsifiable Concentrate

A liquid formulation containing the a.i., one or more solvents, and an emulsifier(s). E or EC formulations are easy to transport, store and measure, require little agitation once they are dispersed in the tank and do not plug nozzles or screens during application. Equipment wear due to abrasion is of little concern with E or EC formulations and these formulations generally leave no visible residue. E and EC formulations are potentially more phytotoxic than dry formulations, may be easily absorbed through the skin and may cause pitting, marring, or discoloration of surfaces. In addition, the solvents and emulsifiers used to make the formulations may be flammable and may damage rubber or plastic components of application equipment. E and EC formulations tend to be more odoriferous than other formulations.

AS or F or L - Aqueous Suspension, Flowable, Liquid

A formulation consisting of the active ingredient attached to finely ground materials which are suspended in a liquid. After addition to water in the tank, particulates with the attached a.i. are suspended in water via agitation. These formulations are: easy to transport, store and measure and seldom clog strainers or nozzles. Good agitation is required to keep the material in suspension and these formulations may leave visible residues.

G or GR - Granules

Formulations designed to be applied without a liquid carrier. The a.i. is absorbed or coated onto coarse particles such as clay or ground corn cob. Advantages of granular formulations are: they are ready to use, simple equipment is used for application, and generally, drift is reduced because the heavy particles settle quickly. Exposure hazards are often reduced with granular formulations due to the relatively low percentage of a.i. and dermal absorption may be reduced due to the dryness of the formulations. When applying granular materials, the public often does not have the perception that pesticides are being applied. In general, coverage with granular formulations will not be as good as coverage with a liquid solution delivered via a properly calibrated boom. Granular formulations will not stick to foliage, may need to be incorporated into soil or planting medium, generally require rainfall or irrigation for activation and may be hazardous to nontarget species such as birds or waterfowl that mistake the granules for seed or gravel. The percentage a.i. in these types of formulations is generally lower than with most other formulations which may increase the cost per unit of a.i.

M or Me - Microencapsulation

Particles of a pesticide, either liquid or dry, surrounded by a coating material which allows for slow release of the a.i. The slow release nature of these formulations often results in the a.i. persisting for a longer period of time compared with other formulations which may be beneficial or detrimental depending on the situation. Since the a.i. is contained within a coating, risk from exposure is usually reduced.

Generally, these formulations have low odor. Good agitation is needed to keep these formulations suspended in water and microencapsulated formulations are usually significantly higher in price than other formulations containing the same a.i.

SP or SG - Soluble Powder, Soluble Granular

Dry formulations which outwardly appear to be Wettable Powders in the case of SP formulations or Dry Flowables or Water Dispersible Granules in the case of SG. Unlike WP, DF and WDG formulations, these formulations dissolve readily in water and form true solutions. When mixed, no further agitation is necessary because the a.i. is dissolved in the water. These formulations do not plug strainers and nozzles and leave little visible residue on treated surfaces. Few formulations of this type are available because the majority of active ingredients are not soluble in water.

ULV - Ultra Low Volume

These are concentrated formulations designed to be applied undiluted or diluted with small amounts of liquid. These formulations are easy to transport and store, require little agitation, are relatively nonabrasive, do not plug nozzles and screens and leave little visible residue. Specialized equipment is required for application and ULV formulations can pose significant drift problems because they are applied as very small droplets. Like E and EC formulations, dermal exposure is a potential hazard during mixing, loading and application of ULV formulations. Solvents used to make these formulations may be corrosive to rubber or plastics.

W or WP - Wettable, Wettable Powders,

The a.i. is combined with a finely ground, dry carrier, usually mineral clay, along with other inert ingredients that enhance the ability of the carrier to disperse and suspend in water. Advantages of these formulations are: ease of transport, storage and application and usually are less phytotoxic than liquid formulations. In addition, these formulations typically are not flammable and are not as likely as liquid formulations to cause damage to surfaces they come in contact with. The dry nature of these formulations prevents saturation of clothing during mixing and loading. Wettable formulations may be abrasive to equipment and plug strainers and nozzles. Often these

formulations pose problems in measuring both from an accuracy standpoint and an exposure standpoint due to the dry, finely ground nature of the material. Good agitation is required to keep these formulations suspended and they may leave visible residues.

WSB or WSP - Water Soluble Bag, Water Soluble Packet

Pre-weighed amounts of dry formulations packaged in water-soluble bags. When the bags are added to water in a spray tank, they dissolve and release their contents to mix with the water. With containment of the a.i. in a soluble bag, risks from inhalation or other routes of exposure are reduced significantly provided the soluble bag is intact. Since the amount of a.i. is premeasured within the soluble bags, the amount of area to be treated needs to conform to the amount of a.i. in an individual bag. Visible residue may or may not be an issue depending on the type of formulated material contained within the soluble bags. Adequate agitation is needed for dissolving the soluble bags and suspending the material contained within the bags. Plugging of equipment may be an issue with these formulations depending on the type of material contained within the bags or how completely the bags dissolve.

Calculating Amounts to Deliver

A thorough understanding of the methodology used to define the amount of active ingredient per pesticide formulation is crucial to delivering the correct amount of pesticide. Many pesticide labels indicate that a prescribed amount of active ingredient be applied to a specific sized area or volume. For example, a pesticide label may instruct the applicator to apply 1.5 lbs a.i. per acre or the label may direct the applicator to apply 3.0 lbs a.i. per acre foot of water. Applicators must be able to accurately determine surface area and or volumes such as acre feet of water or cubic feet within a structure. In addition, they must be able to determine how much active ingredient or product to apply per area or volume based on the pesticide label. Amounts of active ingredient contained in pesticide formulations and type of formulation are listed on the label. The amount of active ingredient per unit of pesticide is represented numerically followed by the type of formulation represented in letters. Formulations of pesticides in which the material itself is in

a dry form denote the amount of a.i. in the container on a percentage basis. A 25W formulation contains 25% a.i. by weight as a wettable formulation. 20G represents a granular formulation that is 20% by weight a.i. Liquid formulations indicate the amount of a.i. on a pounds per gallon basis. A 4E formulation contains 4 lb. a.i. per gallon in an emulsifiable formulation. A 2F contains 2 lb per gallon a.i. in a flowable formulation. If a label instructs the applicator to apply 2 lbs a.i. per acre and the pesticide formulation is a 50WP (50% by

weight a.i. - wettable powder formulation), 4 lbs of the actual formulation needs to be applied per acre to deliver 2 lbs a.i. If the label instructs to apply 1.5 lbs of a.i. per acre and the formulation you are using is a 4F (4 lbs per gallon a.i. - flowable formulation), then you need to apply 1.5 qts per acre of the 4F formulation to deliver 1.5 lbs of a.i. Knowing exactly how to calculate the amount of a.i. to apply based on label instructions is crucial to: effective control programs, reduction of liability and protection of the environment.

Letter Designates of Formulations

A	Aerosol	M/Me	Microencapsulated
AF	Aqueous Flowable	P/PS	Pelleted
AS	Aqueous Suspension	S	Solution
B	Bait	SP	Soluble Powder
D	Dust	ULV	Ultra Low Volume
DF	Dry Flowable	W	Wettable
E	Emulsifiable Liquid	WP	Wettable Powder
EC	Emulsifiable Concentrate	WDG	Water Dispersible Granule
EDF	Extruded Dry Flowable	WSL	Water Soluble Liquid
F/Fl	Flowable	WSB	Water Soluble Bag
G/GR	Granular	WSP	Water Soluble Packet
GL	Gel		

PESTICIDE TRAINING RESOURCES



2525 East Seneca Tucson, Arizona

85716-3018

520-323-3135

www.pttrpest.com