

Pesticide Formulations: Water vs Oil and Powder vs Granules

By Danny L. McDonald, Ph.D., Poultry and Livestock Entomologist, MWI Animal Health, Technical Services

Pesticide active ingredients are rarely used in their pure form. The technical grade active ingredient must be processed into a formulation. These formulations are a usable form for end users with instructions on how they should be mixed and applied. The purpose of the formulation is to improve storage, handling, application, effectiveness and safety.

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Pesticides can be formulated as ready-to-use by the general public or as a commercial preparation that requires a final dilution before application. There are many formulations for various pesticides but the most common formulations used in agriculture, home and garden, and structural pest control are sprays, granules, fumigants and baits. Products that are intended to be applied as sprays can come in a variety of formulations [Table 1]. This article will focus on oil versus water-based formulations and powders versus granular formulations.

Oil-based formulations

First, let's examine some oil-based formulations.

Emulsifiable concentrates (EC) are concentrated oil solutions combined with an emulsifier (Permethrin SFR & Exponent[®] Insecticide Synergist). The emulsifier is a detergent-like material that makes the oil mix in a water solution for spraying. When ECs are mixed with water, the emulsifier causes the oil to disperse evenly through the water. The solution will turn to a milky-white color. However, ECs will eventually settle out of suspension or separate and should be applied immediately after mixing or be constantly agitated. EC formulations are typically more expensive to produce and the solvents may increase dermal toxicity to the applicator; personal protection should be worn as with all pesticides. ECs provide a longer residual

TABLE 1. COMMON PESTICIDE FORMULATIONS AND ABBREVIATIONS

FORMULATION	ABBREVIATION
Aerosol	A
Bait	B
Capsule Solutions	CS
Dust	D
Emulsifiable Concentrate	EC
Flowable	F
Free-Flowable Granule	FG
Granule	G
Ready-to-use	RTU
Solutions (Soluble Liquid Concentrates)	S (SL)
Suspension Concentrate	SC
Ultra-Low Volume Concentrate	ULV
Wettable Powders	WP
Wettable Granules (Water Dispersible Granules)	WG
Water Soluble Granules	WSG

than soluble concentrates (see next page) due to reduced photodegradation (breaking down of pesticides by light).

Oil-based formulations also include products that can be used in fogging machines for mosquito and fly abatement programs (Evergreen[®] 100 Synergized ULV Concentrate). These formulations contain no emulsifier or wetting agent. Some require that you mix them with kerosene, diesel fuel or mineral oil. The thermal fogging device heats up the oil solvent to produce a visible vapor or smoke. Other oil-based formulations are **ready-to-use (RTU)** household and garden insecticide sprays (PT[®] Alpine[®] Pressurized Fly Bait). These usually come in bottles equipped with a spray atomizer or as an aerosol and don't require any dilution.

Ultralow-volume concentrates (ULV) are only available for commercial use and can be water or oil-based products (ULD[®] BP-100). They are usually applied without any dilution with equipment that produces an extremely fine

spray (mist blower). This allows for very little product to be dispersed over a large area.

Water-based formulations

Water soluble concentrates, also called **solutions (S)** or **suspension concentrates (SC)**, are mixed with a water-based matrix and are readily mixed with water to form a liquid spray (Credo[®] SC). SC formulations should not settle out of suspension. These formulations can look like ECs in the undiluted form but do not form a milky solution when mixed with water. The **microencapsulated products (CS)** are also typically water-based (Onslaught[®] FastCap). The active ingredient in a CS formulation is encapsulated with various thicknesses in order for the active ingredient to be slowly released over time. This allows for actives that are easily broken down by sunlight and water (pyrethroids) to be periodically replenished in the treated area.

Powders and granules

Dry sprayables can either be **wettable powders (WP)**, **wettable granules (WG)**, also known as **water soluble granules (WSG)** or **water dispersable granules (WDG)**. WPs are a solid pesticide formulation with talc or clay that is ground into a powder form and applied as suspended particles in water (Rabon[™] 50 WP). The powder does not dissolve. The powder particles are simply uniformly spread out using water as a carrier. They can come in pre-measured packets for a certain volume of water for easy mixing. WP formulations need to be constantly agitated to keep the powder from settling out of suspension. On certain surfaces you may see a visible white residue after an application dries.

WGs are a pesticide formulation consisting of granules that dissolve completely in water (Alpine[®] WSG). Therefore, WGs typically do not necessitate constant agitation unless suggested on the label. These formulations are less messy than WPs and also often come in pre-measured packets for a certain volume of water.

Dry formulations are not intended to be mixed with water before application and are ready-to-use. These include **dusts (D)** and **granules (G)**. Dusts are one of the simplest formulations to apply (ZetaGard[™] LBT). Rather than diluting an active in water or oil, clay dust particles are used as the carrier of the active ingredient. Dusts can be applied with a drop spreader along sidewalls and under feed lines or billow

dusted into cracks, crevices and wall voids (Yellow Jacket Wettable Sulfur II). Dust formulations can be unsightly to some users because they are easily seen for many months after application.

Granule formulations are larger clay particles that are applied by broadcast spreader (Bifen L/P Insecticide Granules). Often times these products should be applied before a rain event or where irrigation equipment can wet them to release the pesticide. Granule formulations should not be confused with **baits (B)** that are to be consumed (Extinguish[®] Plus or Siesta[™] Insecticide Fire Ant Bait). Baits should not be wetted because it will decrease their palatability.

Ultimately, what determines the formulation used is the characteristics of the active ingredient or the preference of the applicator. Some active ingredients aren't formulated as ECs or WPs due to their dermal toxicity to applicators or the environment. Applicators may not choose either of those formulations because their tanks do not have agitators.