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### Insecticide Formulations

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#### ABSTRACT

The properties of insecticides formulations should be understood before choosing a right insecticide which was help to avoid problems and it can be applied in an effective way. The insecticides application equipment must be able to deliver the right amount of pesticide to the targeted pests. Several types of insecticide application equipments like sprayer, duster and granular applicator have different function but each equipment types have their own ways to control a particular pest. The right amount of insecticide should be properly calculated and applied on target pests in effective manner.

#### 1. Introduction

Insecticides are formulated by mixing active ingredients with inert ingredients to make a compatible combination that is effective and safe for use. Active ingredients are the chemical in pesticide products or that portion of a formulation which possesses biological properties that act to control or repel the pests. Formulation is the process of transforming an insecticidal chemical into a product which can be applied by practical methods to permit its effective to apply to target pests. For making a formulation, some factors need to be considered which includes the chemical and physical properties of the active ingredient and the inert materials, the type of application equipments to be used, the nature of the target surface, and the marketing and transport aspects of pesticide usage. There are also certain things to be pondered in regards to compatibility of the inert gradient with active ingredients, compatibility with container and the physical properties of the final combined product. The formulated product must be evaluated to analyse the homogeneity of the product, particle size, storage constancy, retention in the target surface, wetting, penetration and translocation to various parts of the plants, the residual nature, nature of deposit efficacy and its impact on environment, *etc.*

There are many kinds of formulations available in the markets, including liquid, solid and gaseous form. A single active ingredient may be available in different formulations. In agriculture, different types of formulations are frequently used for the application of insecticides employed in pest control programmes. The formulations are named as dusts, Wettable powders (WPs), Emulsifiable Concentrates (ECs), Suspension Concentrates (SCs) or Flowables, Water soluble powder (SPs), Solutions, Granules, Water Dispersible Granules (WGs), Ultra-low-Volume (ULV) formulations, Aerosols, Controlled Release (CR) formulations, Baits, *etc.* The non-insecticidal ingredients of formulations are Solvents, Diluents and Surfactants.

#### 2. Types of formulation

##### 2.1. Dusts

In dust formulation, the toxicant is diluted by milling the insecticidal compound into very fine powered dry pesticides and it consist of active ingredient and carrier. The toxicant in a dust formulation ranges from 0.1- 25 % and the rest consists of carriers. The particles size of dust is 10 microns. The toxicity of an insecticide increases as the particles size decreases. Dusts are to be applied during the early hours of morning when the foliage is still wet with dew to retain the powder.

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## **2.2. Wettable powders (WPs) or Water dispersible powders (WDP)**

They are finely dusts formulation that forms a suspension. Wettable powders formulation is composed of inert materials, wetting and dispersing agents. The active ingredients may vary from 15% - 95%. Wettable powders contain more active ingredient than dust. They are usually to be mixed with water at the time of application as a spray. Wettable powders should never be used without dilution. For application agitation is needed to get soluble powder into solution otherwise there will be certain amount of sedimentation might occur.

## **2.3. Emulsifiable Concentrates (ECs) or (E)**

The formulation is usually in liquid form and it contains the active ingredient, organic solvents and emulsifying agents. When Emulsifiable Concentrates formulation is mixed with water, its forms an emulsion. Generally, they are oil in water the colour of spray solution become milky appearance. The inert ingredients are often highly oils and other solvents.

## **2.4. Suspension Concentrates (SCs) or Flowables**

A suspension concentrate or liquid formulation combines many of the characteristics of emulsifiable concentrates and wettable powders. In this formulation, the active ingredient is usually a solid that does not dissolve in either water or oil. The powder is then suspended in a small amount of liquid. Suspension is to be diluted with water for application.

## **2.5. Water soluble powder (SPs)**

When soluble powder mixed in water and dissolve readily forming a true solution and this formulation look like wettable powder. Some agitation is needed to get soluble powder into solution, but after they dissolved additional agitation is not needed. SPs are usually 50 % or more active ingredients and always require dilution.

## **2.6. Solutions(S)**

Solutions are active insecticide ingredients dissolve readily in a liquid solvent that may be used directly or required diluting. When mixed, they form a solution that does not settle out or separate. These formulations usually contain the active ingredient, solvent, and one or more other ingredients.

## **2.7. Granules(G)**

Granules (G) are quite similar to dust formulation but they are larger and break down more slowly. The active ingredients in granular formulations are low and may vary from 1-40 %. The particles settle quickly and no needed mixing with water. Granular formulation is used mostly used against soil insects like nematodes *etc.*

## **2.8. Water Dispersible Granules (WGs)**

Water dispersible granules formulation appears as small granules. Water dispersible granules formulations are mixed with water for application, they break apart similar to wettable powder and constant agitation is needed to get soluble powder into solution. The active ingredients become distributed throughout the spray mixture.

## **2.9. Ultra-low-Volume (ULV) formulations**

These formulations are used on large areas of land to treat by spraying, *i.e.* hectares can be treated in one day. These are applied with the help of droplet applicator (CDA). They remain in solution and needed less agitation. These are used mainly in agricultural, forestry *etc.* For aerial or ground spray equipments, total volume dispersed does not exceed 1 or 2 litres/ha.

## **2.10. Aerosols**

Aerosols formulations are minute particles suspended in air as a fog or mist which is normally gaseous but can be liquefied under at ordinary temperature. The active ingredients have a low percentage in aerosols formulations. They are mostly used for household and garden pests, but not for agricultural purpose.

## **2.11. Controlled Release (CR) formulations**

These formulations which allow much less active ingredients to be used for the same period of activity. Controlled release formulations of pesticides are retarding repositories, which release their biologically active constituents into their environment over a defined period of time (Bahadir and Pfister, 1990).

## **2.12. Baits**

Poisonous baits are insecticides mixed with preferred food of the target pests which can easily consume the mixed with toxicants. Normally, baits are used along with toxicants for control of rodents, locust, ants and other insects. The active ingredients are low percentage in poisonous baits.

### 3. The non-insecticidal ingredients of formulations

#### 3.1. Solvents

A solvent is a substance, used for insecticides are soluble by dissolved. They are usually a liquid, but can also be a solid or gas. An example of solvents - a liquid, such as water, kerosene, xylene, or alcohol that will dissolve a pesticide to form a solution.

#### 3.2. Diluents

Diluents are substance which combined with any concentrated insecticides and used to dilute an insecticide. Diluents can be either liquid or solid. Liquid diluents are usually water or refined oils while, solid diluents are used to formulate insecticide dusts or granules.

#### 3.3. Surfactants

The term surfactants are derived from "Surface Active Agent". Surfactants may act as emulsifying, wetting agents, foaming agents and dispersants. Surfactants are materials that added to the insecticide formulation to enhance mixing.

### 4. Insecticide application equipment

Equipment for pesticide application should be decided what type of equipment is needed – sprayer or duster and if sprayer is needed, high or low volume. The nature and habits of the target pest involved are to be covered and crops or crops involved will determine the type to be procured. In case of sprayers, the ability to withstand rough handling and durability are to be considered in the choice of the right type of machine. Normally, insecticide application equipments are expected good coverage with minimum expenditure and they should be easily operated and convenient. Proper techniques of application not only aid in effectiveness but also ensure public protection, and protection of the environment. A brief detail of the types of insecticide application equipment is presented in the following: - a) sprayers, b) dusters and c) granule applicators.

#### a. Sprayers:

They are mainly used for applying insecticides in liquid form, the diluents being water or in some cases, oil. They may be either hand operated or electrically operated or power sprayer. The most commonly used sprayer is the hand atomiser, fine mist or spray can be obtained by this machine which carries a small tank at the base of a syringe and sends out a spray through a nozzle.

Different nozzles are available for emitting a jet at right angles for spraying under leaf. The common sprayer used for domestic purpose is the bucket pump sprayer. Most efficient hand sprayer is the Knapsack sprayer. The most convenient machinery for large scale operations is the compressed air sprayer and they consist of a pump fitted in a tank which is operated by hand.

#### b. Dusters:

Various forms of dusts also play an important part in deciding the types of dusters machinery to be used. Dust formulations are insecticides in which the active ingredient is mixed with a substance which is usually light in weight. The common hand dusters are hand blowers. For large scale operation, rotary blower and knapsack dusters are used. The fan is installed inside the machinery which is operated by hand. The dusters are impelled by electric motors for dusting large tracks.

#### c. Granular applicator:

Granular applicator is machinery that applies granular insecticides and its convenient machinery for applying granules formulation for control of insects on plants. They are uniformly distribution of granular insecticides and herbicides and to provide accuracy. This machinery is used to improve crop quality. Granular applicators are either targeted or broadcast. Most common granular applicators are the row crop applicator.

### Conclusion

An insecticide formulation is the one which is composed of both active and inert gradients. The active gradient works as the insecticide and the inert gradients function as the carrier and adjuvants. Insecticides users must consider several factors while selecting a formulation. The risk associated with the use and its impact on environment after reaching the target site is also considerable.

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