INSECTICIDE FORMULATIONS
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- **AI** = active ingredient, chemicals that are responsible for the pesticidal effect
- **Inert ingredient** = any substance in a pesticide formulation having no pesticidal action
- **Formulation** = the way a pesticide is prepared for practical use
- **Carrier** = inert liquid or solid added to an active ingredient to prepare a pesticide formulation
What?

Formulations of Insecticides: processing of the toxic substance to improve its properties of storage, handling, application, effectiveness, and safety to the applicator and environment and profitability. It is the final physical condition in which insecticide is sold.

Why?

• To come into direct contact with the pest or leaf.
• Uniform and persistent deposit upon the plant surface.
• Since very small quantity of toxicant is required to be distributed over a large area.
• Formulated in a form suitable for use as a spray, dust or fumigant.
1. Dusts (D):
   - ready to use insecticides in powder form
   - Diluted by a suitable finely divided carrier
   - Carrier may be an organic flour or pulverized mineral or clay
   - Toxicant ranges from 0.15 to 25%
   - Particle size is less than 100 microns
   - With Decrease in particle size, the toxicity increases
   - Easy to apply, less labour and water is not necessary
   - Loss of chemical occurs due to wind drift
   - Done in calm weather, early morning hours when the plant is wet
   - Eg. HCH 10% dust; Endosulfan 4% D

2. Granules or Pelleted insecticides (G):
   - Ready to use granular forms
   - Composed of a base fused with the toxicant
   - Particle size 0.25 to 2.38 mm
   - Contains 1 to 10% concentration
   - Applied in water or whorls of plants or in soil
   - Action may be by vapour or systemic
   - very little drift and no undue lose of chemical
   - Undesirable contamination is prevented
   - Residue problem is less
   - Release of toxicant is achieved over a long period
   - Easy for application as water is not required
   - Less harmful for natural enemies
   Eg: Carbofuran 3G, Phorate 10 G, Cartap hydrochloride 4G
3. *Wettable Powders (WP)*: It is a powder formulation

- To be *diluted with water* and applied
- Yields a *stable suspension* with water
- *Active ingredient* (toxicant) ranges from 15 to 95%
- Toxicant is blended with a *diluent*, a *surfactant* and an *auxiliary material*
- Sometimes *stickers* are added to improve retention on plant surface
- Loss of chemical *due to run off*
- More water is required

**Eg**: Carbaryl 50%WP, Thiodicarb 75%

4. *Emulsifiable Concentrates (EC)*:

- Contains the *toxicant*, a *solvent* and an *emulsifying agent*
- Yields an emulsion of *oil-in water* type, with water
- Active ingredient (toxicant) ranges from 2.5 to 100 %
- When sprayed the solvent and water evaporates quickly leaving a deposit of toxicant
- The emulsifying agents are *alkaline soaps, organic amines etc.*
- Eg: Endosulfan 35EC, Profenophos 50EC
5. Soluble Powder or Water Soluble Powder (SP or WSP): readily soluble in water
   • Surfactants improves the **wetting power** of the spray fluid
   • **Anti-caking agent** is added which prevents formation of lumps in storage
   • Usually contains a **high concentration of toxicant**  
     **Eg:** Acephate 75 SP

6. Suspension Concentrate (SC):
   • Active ingredient is absorbed on to a **filler which is then suspended in a liquid matrix** (water)
   • It is not dusty and easier to disperse in water  
     **Eg:** Imidacloprid 50 SC

7. Flowables (F): When an **ai is insoluble**, a flowable formulation is developed
   • Toxicant is **milled with a solid carrier** and dispensed in a small quantity of water
   • Prior to application it has to be diluted with water
   • Flowables do not usually clog nozzles and require only moderate agitation  
     **Ex:** Methoxyfenozide (Intrepid 2F)

8. Water Dispersible Granules (WDG): appears as small pellets or granules
   • When the granules are mixed with spray water, they break apart and, with agitation, the active ingredient becomes distributed throughout the spray mixture.
     **Ex:** Thiamethoxam 25 WDG
9. **Solutions:** water insoluble but soluble in organic solvents like amyl acetate, kerosene, xylene etc.,

- Some toxicants are dissolved in organic solvents and used directly for the control of household pests. Eg. Baygon

10. **Concentrated insecticide liquids:** the toxicant at highly concentrated level is dissolved in non-volatile solvents

- Emulsifier is not added
- Generally applied from **high altitudes** in extremely fine droplets
- **Never diluted with water** at ultra volume rate
- There is greater residual toxicity and less loss through evaporation
- Active ingredient ranges from 80-100%  
  - Eg: Malathion, Bifenthrin, Fenitrothion.

11. **Insecticide aerosels:**

- Toxicant is suspended as minute particles 0.1 to 30 microns in air as fog or mist
- The toxicant is dissolved in a liquified gas and if released through a small hole
- causes the toxicant particles to float in air with rapid evaporation of the released gas  
  - Eg: Allethrin

12. **Fumigants:** volatile at ordinary temperature and sufficiently toxic is known as fumigant

- Most fumigants are liquids held in cans or tanks
- They are mixtures of two or more gases
- places not easily accessible to other chemicals can be easily reached  
  - Eg: Aluminium phosphide
13. Microencapsulation: consist of dry and liquid pesticide particles enclosed in tiny plastic capsules
• Mixed in water and sprayed
• The capsule slowly releases the pesticide
• Prolong the active life of the pesticide by providing timed release of the active ingredient  
  Ex: Lambda-cyhalothrin

14. Baits: In baits, a.i is mixed with edible substance
• These are always stomach poisons
• made up of 3 components, Poison (Insecticide carbaryl), Carrier or base(Rice bran), and Attractant (Jaggery) at ratio of 1:10:1
• Poison should be strong and easily soluble
• Base is the filler like rice bran with just enough water

14. Insecticide Mixtures: Involve combinations of two or more insecticides in the right concentration into a single spray solution
• savings in labor costs
• The use of pesticide mixtures may result in synergism or potentiation (enhanced efficacy) and the mitigation of resistance
  Ex: Chlorpyriphos 16% + Alphacypermethrin 1% EC
  Chlorpyriphos 50% + Cypermethrin 5% EC
1. Addition of Surfactants improves the wetting power of the spray fluid, *e.g.* Triton X-100, Teepol, Tween-85 and soap.

2. Deflocculators/spreaders: Materials added to a spray to lower the surface tension and improve spread over a given area. *e.g.* Calcium casinate

3. Stabilisers: Chemicals added to a pesticide formulation which resist chemical degradation over a period of time.  
   *e.g.* Isopropyl cresols for Pyrethrins, Hexamethyene tetramine for Endrin, Epichlorohydrin for Aldrin and Toxaphene.

4. The adverse effect caused by some insecticides on plants is known as **Phytotoxemia.**

5. **Softeners** are the substances that reduce the phytotoxicity of an insecticide, *e.g.* Sulphur, Zinc sulphate, lime and casein.

6. **Humectants** increase the time of drying of applied spray particles. They keep the surface moist. *e.g.* Glycerine.

7. A toxic compound when used with another toxic compound increases the toxicity is called **Potentiation.**

8. The compound enhancing the toxicity of another compound when combined with it is called **synergist.** *e.g.* Piperonyl Butoxide (non toxic) + Pyrethroids (toxic)  
   Piperonyl cyclonene (non toxic) + DDT (toxic)

9. Oleic acid is a Pseudosynergist. It stabilizes the droplet size and increases toxicity of the insecticide.

10. Pyrethroids have high synergetic ratio.

11. The compound inhibiting the toxicity of another compound when combined with it is called **antagonis.**