Pesticide Formulations

Chapter 4

National Pesticide Applicator Certification Core Manual
Pesticide Formulations

- This module will help you:
- Recognize formulation abbreviations
- Identify formulation advantages and disadvantages
- Understand role of adjuvants
Important Definitions

- **Active Ingredient (Ai)** - the actual chemical in the product mixture that controls the pest
- **Inert Ingredient** - other materials added with the AI when the product is formulated
- **Phytotoxicity** - plant damage
- **Adjuvant** - product added to spray tank to assist pesticide in its application
Pesticide Formulation

Formulations consist of:

• **Active ingredient, (Ai)**—the pesticide/s that actually control the pest.
• **Carrier**—such as an organic solvent or mineral clay.
• **Surface-active ingredients, ‘surfactants’** such as stickers or spreaders.
• **Other ingredients**, such as stabilizers or dyes.
Pesticide Formulation

active ingredient (Ai)
each Ai will be listed

+

inert ingredients
water, emulsifiers
solvents, dry carrier material
stabilizers, dye
surfactants: spreaders, stickers
wetting agents
Pesticide Spray Batch

Pesticide Formulation

+ 

Water or oil

Spray additives=Adjuvants
Product Formulations

Active and Inert Ingredients

Lexone DF

- **Active Ingredient**
  - Metribuzin \((4\text{-amino-6-1-1 dimethlyethly-}3\text{-methythio 1,2,4,triazine 5 4H-one})\) 25%
- **Inert Ingredients** 75%
- **TOTAL** 100%
- **EPA Reg. No. 12333-344**
### Lexone DF

- **Active Ingredient**
  - Metribuzin 25%
- **Inert Ingredients** 75%
- **TOTAL** 100%

*contains 2 lbs metribuzin per gallon

### Lexone 2E

- **Active Ingredient**
  - Metribuzin* 25%
- **Inert Ingredients** 75%
- **TOTAL** 100%

*contains 2 lbs metribuzin per gallon
Why Add Inert Ingredients?

1. For ease of pesticide product handling
2. Inerts make measuring and mixing pesticides easier
3. To provide for safety
4. Makes the Ai work better
   • Better penetration
   • More selectivity
   • Increased effectiveness
Adjuvant

- The term adjuvant basically means additive (you need to memorize it)
  - Formulation additive
  - Additive which is sold separately to mix with the product when tank mixing
- Labels will often recommend to add an adjuvant
- Include surfactants, spreaders, wetting agents, colorant dyes, buffers, antifoaming agents, safeners, etc.
Deciphering the Ai Code in Product Names

80SP
80% active ingredient by weight
Soluble Powder

1EC
1 lb Ai/gallon
emulsifiable concentrate

40DF
40 % active ingredient
Dry Flowable
# Brand Name Abbreviations

- **Often brand names include abbreviations that describe something about the formulation:**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>dust</td>
</tr>
<tr>
<td>G</td>
<td>granular</td>
</tr>
<tr>
<td>SP</td>
<td>soluble powder</td>
</tr>
<tr>
<td>S</td>
<td>solution</td>
</tr>
<tr>
<td>WP</td>
<td>wettable powder</td>
</tr>
<tr>
<td>EC</td>
<td>emulsifiable concentrate</td>
</tr>
<tr>
<td>DF</td>
<td>dry flowable</td>
</tr>
<tr>
<td>WDG</td>
<td>water dispersible granule</td>
</tr>
<tr>
<td>WSP</td>
<td>water soluble packet</td>
</tr>
<tr>
<td>ULV</td>
<td>ultra low volume</td>
</tr>
<tr>
<td>RTU</td>
<td>ready to use</td>
</tr>
<tr>
<td>GL</td>
<td>gel</td>
</tr>
<tr>
<td>LO</td>
<td>low odor</td>
</tr>
</tbody>
</table>
Selecting a Formulation

- Evaluate advantages and disadvantages
- Do you have the right application equipment?
- Can the formulation be applied when and where it is needed?
- Will the formulation reach the target pest and be there long enough?
Spray Mix Terminology

- solution
- suspension
- emulsion

How does it really mix in the spray tank?
Solution

Active Ingredient
Either liquid or dry substance
TRULY **dissolves** in water

just like sugar in water
*usually transparent*
Suspension

Solid particles suspended in a liquid like hot chocolate

Active Ingredient (high %) impregnated onto Dry Carrier and mixed with an Emulsifier (slick, soapy)

Agitation required
Emulsion

One liquid dispersed within another liquid like milk

Ai is dissolved in oil (oil/ai droplet) and mixed with an emulsifier. Ai/Oil mixture is suspended in water forming a white emulsion.
Liquid Formulations

Emulsifiable Concentrate (E or EC)

Active ingredient (liquid) dissolved in a petroleum-based solvent with an emulsifier added

- Turns white when mixed
- Smells of solvents
Liquid Formulations

Emulsifiable Concentrate (E or EC)

High Ai%

**ADVANTAGES**

- Easy to handle
- Little agitation
- Relatively easy on equipment
- Leaves little residue

**DISADVANTAGES**

- Phytotoxic – plant injury
- Easily absorbed by the skin
- Flammable
- Deterioration of rubber and plastic hoses
Liquid Formulations

Solutions (S)

Ai dissolves in liquid carrier; once mixed with water, solutions do not settle out

product  diluted
Liquid Formulations
Solutions (S)

ADVANTAGES
- Easy to handle
- No agitation
- Easy on equipment
- No residue
- Used indoors/outdoors

DISADVANTAGES
- None
Liquid Formulations

Ready-to-Use Low Concentrate Solutions (RTU)

Easy and relatively safe to handle

Less than 1% per unit volume of active ingredient; high cost
Liquid Formulations

Ultra-Low Volume (ULV)

- Special-purpose formulation
- Almost 100% active ingredient
- Agriculture, forestry, mosquito control
Liquid Formulations

Ultra-Low Volume (ULV)

**ADVANTAGES**
- Easy to handle
- Little or no agitation
- Easy on equipment
- No residue
- Will not plug nozzles
- Used indoors/outdoors

**DISADVANTAGES**
- High drift hazard
- Easily absorbed through skin
- Specialized equipment needed
- Solvent wear on rubber and plastic
- Calibration critical
# Liquid Formulations

**Emulsifiable Concentrate (EC or E)**

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to handle</td>
<td>High drift hazard</td>
</tr>
<tr>
<td>Little or no agitation</td>
<td>High Ai (24-75%)</td>
</tr>
<tr>
<td>Easy on equipment—will not plug screens or nozzles</td>
<td>May cause phytotoxicity</td>
</tr>
<tr>
<td>No visible residue</td>
<td>Solvent wear on rubber and plastic</td>
</tr>
<tr>
<td>Used indoors/outdoors</td>
<td>May be corrosive</td>
</tr>
<tr>
<td></td>
<td>Highly absorbable through skin</td>
</tr>
</tbody>
</table>
Liquid Formulations

Invert Emulsions

- Oil carrier with water-soluble pesticide – consistency of mayonnaise
- Reduce drift and runoff
- Sticker-spreader
- Specialty uses: Rights-of-way and near sensitive areas
Liquid Formulations
Flowables (F) Liquids (L)

**ADVANTAGES**
- Easy to apply

**DISADVANTAGES**
- Abrasive to nozzles and pumps
- Require constant agitation
- Leave visible residues
Liquid Formulations
Flowables (F) or Liquids (L)

Flowables are basically a wettable powder pre-mixed with a liquid carrier.
Liquid Formulations

Aerosols (A)

- Some are ready-to-use, often available in small quantities
- Little active ingredient
- High drift potential

- Some require highly specialized equipment
- Risk of inhalation injury—respiratory protection needed
- Difficult to confine
Liquid Formulations
Aerosols for Smoke of Fog Generators

**ADVANTAGES**
- Easy fill a large, enclosed space

**DISADVANTAGES**
- Require highly specialized equipment
- Difficult to confine
- May require respiratory equipment to prevent inhalation injury
Dry Formulations

Baits (B)

A bait is an example of a dry or liquid product that is applied without mixing.
Dry or Solid Formulations

Baits (B)

ADVANTAGES
- Ready to use
- Coverage not critical
- Control pest that move in and out of area

DISADVANTAGES
- Attractive to children
- May kill domestic animals and wildlife
- Dead pest odors
- Old bait may serve as food source if inactive
- Baits may kill predators of the pests that the baits were places for
Dry Formulations
Pastes (P), Gels (GL)

A bait formulated as a paste or gel that is applied with a syringe or bait gun

- Odorless
- Minimal exposure to applicator, humans, pets
- Easy to place
- Melt at high temperatures
- May stain porous surfaces
- Repeat application can create unsightly buildup
Dry or Solid Formulations
Dusts (D) and Granules (G)

- Ready-to-use
- Can reach hard to get places
- Very little active ingredient
- Very fine, dry inert carrier
- High drift potential
- Distribution and calibration a problem
- Dusts: Irritating to eyes, nose, throat, skin
Dry Formulations
Granules (G) and Pellets (P or PS)

- Granules: can be mistaken for food/feed
Dry Formulations + Water

- Buy Dry --> Mix with water --> Spray
- Wettable Powders (WP)
- Water Dispersible Granules (WDG)
- Dry Flowables (DF)

Active Ingredient (high %)
Dry Carrier
Emulsifier (slick, soapy)
Dry Formulations

Wettable Powders (WP or W)

Wettable powders settle out quickly, therefore require constant agitation in the spray tank.

**product**  **diluted**
Dry Formulations
Wettable Powders (WP or (W))

**ADVANTAGES**
- Easy to store
- Easy to measure/mix
- Relatively less harmful to plants, animals and surfaces than ECs
- Less absorption by human skin and eyes

**DISADVANTAGES**
- Inhalation hazard
- Require Constant agitation
- Difficult to mix in hard water
- Abrasive to pumps and nozzles
- Visible residues
Dry Formulations

Water-dispersible Granules (WDG) or Dry Flowables (DF)

These materials possess some of the same characteristics as wettable powders except they are formulated into granular-sized particles, so are easier to handle with little inhalation hazard.
Dry Formulations

Soluble Powders (SP or WSP)

- Forms true solution, like sugar – no agitation
- Ai is 15-95% by weight
- Few pesticides are soluble powders
Dry Formulations
Soluble Powders (SP or WSP)

**ADVANTAGES**
- Easy to measure/mix
- Form true solution
- Little phytotoxicity concern
- Less absorption by human skin and eyes

**DISADVANTAGES**
- Inhalation hazard
Other Formulations

- Microencapsulated
- High toxicity Ai in encased formulation
- Water-soluble packets
- No human exposure when mixing
Other Formulations

- Attractants/Repellents
- Impregnates
- Pesticide/Fertilizer Combination
- Animal Systemics
Other Formulations

Fumigants

- Active as a poisonous gas, penetrates cracks, crevices, and stored commodities
- Highly toxic to all living organisms
- Very high risk of inhalation exposure
- Specialized protection equipment; enclosed space
Pesticide Mixtures

- **Tank mixing** multiple products is legal **unless** prohibited by the label
- Manufacturer only warranties their product alone or product mixtures listed on the label
- Manufacture notes *known* incompatibilities on label
- **Incompatibility**
  - Heat, clumping, precipitate
  - Inactivity of active ingredients
  - Increased risk of phytotoxicity
  - Use Jar-Test to test for incompatibility
  - Field incompatibility can still occur
Adjuvants
purchased additives to add to tank mix
or added during formulation process

Surfactants - group

- Wetting agents
- Spreaders
- Emulsifiers
- Stickers/Extenders

Others

- Buffers
- Compatibility agents
- Defoaming agents
- Colorants/dyes
- Safeners
- Thickeners
Adjuvants
How to choose the right one?

- Read the pesticide label for recommendations
  - Some may prohibit use of an adjuvant
- Don’t use industrial products or household detergents
- Test before you spend $$
- Remember, many pesticide products contain an adjuvant!
CHAPTER 4

Formulation Summary

- Active and inert ingredients
- Dry and liquid formulations
- Adjuvants
- Choose a pesticide formulation that will best suit your pest problem and target site
CHAPTER 4

Formulation Summary

- Choose a pesticide formulation that will best suit your pest problem and target site
  - Safety, ease of use
  - Human exposure concerns
  - Phytotoxicity; visible residues
  - Application equipment considerations
Q1. Which of the following formulations typically has the lowest rate of active ingredient?

A. Dusts (D)
B. Wettable Powders (WP)
C. Emulsifiable Concentrate (EC)
D. Soluble Powder (SP)
Q2. Which type of nozzle would pose a concern when using soluble powder formulations?

1. no nozzle type poses a concern
2. brass nozzles
3. aluminum nozzles
4. nylon nozzles

A. 1 only
B. 2 and 3 only
C. 2 and 4 only
D. 3 and 4 only
Q3. Which of the following are considered surfactant-type adjuvants?

1. spreaders
2. buffers
3. wetting agents
4. colorant dyes

A. 1 and 2 only  
B. 1 and 3 only  
C. 2 and 3 only  
D. 3 and 4 only