Chapter 4: Formulations

Remember, *formulation* is the physical *FORM* that the pesticide comes in.

*(not the % active ingredient)*
The Active Ingredient of a pesticide usually cannot be added to the carrier without modification, so the manufacturer may add Inert Ingredients such as fillers, solvents, wetting agents, stickers, etc.

This is called a **Formulation**.
Active Ingredient
the substance that actually controls the pest

Inert Ingredient
non-pesticidal ingredients that make it usable, so it can be sprayed or applied somehow.
The **Formulation** must usually be added to a “carrier” such as water, oil or air so that it can be handled by application equipment and applied evenly to the target area.
This combination is called a **DILUTION**
What is in a name?

Trade name = brand name = product name
  example: Deep Woods OFF!

Chemical name (complex)
  N,N-diethyl-meta-toluamide

Common name (simpler)
  DEET
Formulations

Applied as liquids...
Formulations

- Emulsifiable Concentrates (EC)
  - contains petroleum based solvents (strong odor)
  - contains an emulsifying agent (emulsifier)
    - allows it to mix with water to form an emulsion

- Advantages:
  - Easy to handle, transport, and store
  - require little agitation in the tank
  - not abrasive, wont clog nozzles
  - little to no visible residue on treated surface

- Disadvantages
  - Can be flammable
  - high conc. makes it easy to over or under apply
  - corrosive to plastics and rubber
  - easily absorbed thru skin
Formulations

- Solution (S)
  - Simply dissolved in a carrier

- Advantages:
  - solution is maintained when mixed with a similar carrier in tank – little agitation
  - can be used indoors or out
Formulations

- Wettable Powders (WP or W)
  - dry, finely ground
  - applied as a liquid
  - one of the most widely used formulations

- Advantages:
  - easy to store, transport
  - less harm to treated surface, plant or animal
  - skin adsorption less likely than EC

- Disadvantages:
  - needs constant agitation
  - inhalation hazard high
  - can be difficult to mix
  - abrasive to equipment, and can clog
Formulations

- Soluble Powders (SP)
  - dry, finely ground like WP
  - applied as a liquid like WP
  - actually dissolves into solution
- Advantages:
  - does not need constant agitation like WP
- Disadvantages
  - inhalation hazard high
  - rare since few actives will dissolve in water
Formulations

• Flowables (F or L)
  • ai does not dissolve in anything and is therefore impregnated into ground clay and suspended in a thick, concentrated liquid

• Advantages:
  • easy to handle and apply

• Disadvantages:
  • require moderate agitation
  • must shake well before using
Formulations

- Water-Dispersible Granules (WDG)
- Dry Flowable (DF)
  - granules that break apart in water to become a like a WP
- Advantages:
  - easily measure and mixed
  - less inhalation and skin exposure due to granules
- Disadvantages
  - need constant agitation
Formulations

- Ready-To-Use (RTU)
  - low concentrate solutions
- Advantages:
  - easy to use – no measuring or mixing
  - homeowner friendly
- Disadvantages
  - low concentration = not cost effective
Formulations

- **Ultra-Low-Volume (ULV)**
  - Very concentrated in a small amount of carrier, outdoor use in: Ag, Forestry, Ornamental and Mosquito control
- **Advantages:**
  - easy to store, handle and transport
  - little to no agitation
- **Disadvantages**
  - very easy to over- or under-dose
  - difficult to avoid drift
  - dangerous to use
  - need specialized equipment
Formulations

- Invert Emulsion
  - water soluble pesticide in an oil carrier
  - mostly for ROW herbicides, or invasive plant control
- Advantages:
  - reduce drift
  - good rain resistance
  - spreader/sticker built in
- Disadvantages
  - difficult to get good coverage
Formulations

- Aerosol (A)
  - low % ai in a solvent

- Advantages:
  - ready to use
  - portable
  - easy to store
  - convenient
  - stable

- Disadvantages
  - inhalation risk
  - hazardous if punctured or catches fire
  - not cost effective
Formulations

Applied dry...
Formulations

- Dusts (D)
  - ready to use formulated with a very fine, dry, inert carrier of talc, chalk, clay, nut hulls, volcanic ash
  - used in structures and on livestock
- Advantages:
  - work in hard-to-reach places like wall voids
- Disadvantages
  - dampness can cause clogging of equipment
  - do not stick to surfaces
  - inhalation hazard, plus irritates eyes, nose, throat, skin
Formulations

- Granules (G)
  - ai is on or part of course particles made from clay, corn cobs or walnut shells
  - usually for soil application

- Advantages:
  - ready to use, with simple equipment
  - slow release
  - low drift

- Disadvantages
  - difficult to apply uniformly
  - may need moisture to release ai
  - risk to birds
Formulations

- Pellets (P or PS)
  - same as granules, except consistent size and shape

- Advantages:
  - can be used with more precise spreaders than granules

- Disadvantages
  - limited use
Formulations

- Baits
  - ai mixed with food or other attractive substance, solid, liquid, gel or paste
- Advantages:
  - can be applied C&C to avoid food or human exposure
  - can be removed after use
- Disadvantages
  - dead rodents are smelly
  - old bait can feed pests
Formulations

- microencapsulated
  - solid or liquid ai inside a tiny, plastic particle that breaks or degrades over time

- Advantages:
  - residual activity
  - safer than other formulations

- Disadvantages
  - hazardous to bees – pollen-sized
  - re-entry periods can be longer
Formulations

- Fumigants (F)
  - forms a poisonous gas
  - usually agricultural or structural use
  - kills just about everything it contacts
- Advantages:
  - penetrates well
  - no residual
- Disadvantages
  - must be enclosed somehow
  - very dangerous to use
Choosing a Formulation

- Things to consider:
  - Will it stay in place long enough?
Choosing a Formulation

- Things to consider:
  - Will it stay in place long enough?
  - Risks to you, environment and treated site?
Choosing a Formulation

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  - Have the equipment and PPE needed to apply it?
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  - Equipment concerns such as agitation, clogging, wear?
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Choosing a Formulation

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  - Need to dilute it, and in what carrier?
Choosing a Formulation

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  - Have the equipment and PPE needed to apply it?
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  - How much you will need to apply this time, or this season?
Choosing a Formulation

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  • Will it stay in place long enough?
  • Risks to you, environment and treated site?
  • Have the equipment and PPE needed to apply it?
  • Equipment concerns such as agitation, clogging, wear?
  • Ease of handling and measuring?
  • Need to dilute it, and in what carrier?
  • How much you will need to apply this time, or this season?
  • Price?
Formulations

- What do the numbers mean?
  - Liquid = pounds of active ingredient / gallon
  - Dry = % of active ingredient by weight
ACTIVE INGREDIENT
Clethodim: (E)-2-[1-[[3-chloro-2-propenyl]oxy]imidazol-5-yl]-2-(2-ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one 26.4%
OTHER INGREDIENTS: 73.6%
TOTAL 100.0%

Contains petroleum distillate. Contains 2.0 lbs. clethodim per gallon.
Contains clethodim, the active ingredient used in Select® herbicide and Prism® herbicide.
Arrow 2 EC Herbicide is not manufactured or distributed by Valent U.S.A. Corporation.

KEEP OUT OF REACH OF CHILDREN
CAUTION
Si usted no entiende la etiqueta, busque a alguien para que se le explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

Manufactured For:
Makhteshim Agan of North America, Inc.
4515 Falls of Neuse Road
Suite 300
Raleigh, NC 27609

For additional precautionary, handling and use statements, and First Aid instructions, see inside of this booklet.

EPA Reg. No. 66222-60

Net Contents: 1 Gallon
MARATHON® 60 WP
GREENHOUSE and NURSERY INSECTICIDE in Water Soluble Packaging

For Systemic Insect Control on Ornamental and Vegetable Plants in Greenhouses, Nurseries and Interior Plantscapes

ACTIVE INGREDIENT:
Imidacloprid, t-[(5-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine 60.0%
OTHER INGREDIENTS: .................................................. 40.0%
TOTAL: .................................................. 100.0%

Keep water soluble packets in this container and store in a cool dry place but not below freezing (32°F).
Do Not Remove Packets From Container Except For Immediate Use.

EPA Reg. No. 432-1361-59807
STOP - READ THE LABEL BEFORE USE
KEEP OUT OF REACH OF CHILDREN

CAUTION
PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed, inhaled, or absorbed through skin. Causes eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing dust or vapor.
Personal Protective Equipment (PPE):

FIRST AID

IF SWALLOWED
• Call a poison control center or doctor immediately for treatment advice.
• Have person sip a glass of water if able to swallow.
• Do not induce vomiting unless told to do so by the poison control center or doctor.
• Do not give anything by mouth to an unconscious person.

IF INHALED
• Move person to fresh air.
• If person is not breathing, call 911 or
PENDulum®
granule herbicide

FOR USE IN
Turfgrasses, Ornamentals, Landscape or Grounds Maintenance, and Noncropland Areas

ACTIVE INGREDIENT:
pendimethalin, N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitrobenzenamine ............... 2.0%

INERT INGREDIENTS ........................................... 98.0%
TOTAL .............................................................. 100.0%

(40 lbs. contains 0.8 lb. of pendimethalin)

EPA Reg. No. 241-375
Indar®

2F

Fungicide

Active Ingredient
fenbuconazole: a-[2-(4-chlorophenyl)ethyl]-a-
phenyl-1H-1,2,4-triazole-1-propanenitrile.................................................. 23.5%
Other Ingredients ......................................................................................... 76.5%
Total ............................................................................................................ 100.0%

Contains 2 lb of active ingredient per gallon
U.S. Patent No. 4366165

EPA Reg. No. 62719-416
Adjuvants

- Improves the effectiveness of the active ingredient
- Added to either the formulation by the manufacturer, or to the spray tank mix by the applicator
- Have no pesticidal activity
Adjuvants

- Surfactants (wetting agents, spreaders)
  - Help to wet the treated surface and the spray droplets to spread out evenly
  - Important for treating plants with waxy or hairy leaves
  - Too much is not good
Adjuvants

- Stickers (and Extenders)
  - Increases adhesion of particles to treated surface
  - Improves rainfastness
  - Can reduce evaporation
  - Can reduce photodegradation
Adjuvants

- Plant Penetrants
  - Enhance penetration of some pesticides into plants
  - Increases pesticidal activity
Adjuvants

- Compatibility Agents
  - May eliminate clumping when tank mixing pesticides or fertilizers
Adjuvants

- Buffers and Acidifiers

  - Prevent degradation by acidifying and stabilizing the water in the tank

  - Must be added prior to pesticides or other adjuvants
Adjuvants

- Drift Control Additives
  - Increases average droplet size from sprayer
  - May reduce effectiveness slightly
Adjuvants

- Thickeners
  - Increases viscosity of spray mix
  - Slows evaporation and allows systemic pesticides to penetrate
Adjuvants

- Defoaming Agents
  - Some formulations may get foamy with mixing or agitation
  - Slows evaporation and allows systemic pesticides to penetrate
Adjuvants

- Foaming Agents
  - Can be used to reduce drift
  - Foam applications are used to fill voids
    - In walls
    - Under slabs
    - Sewer root control