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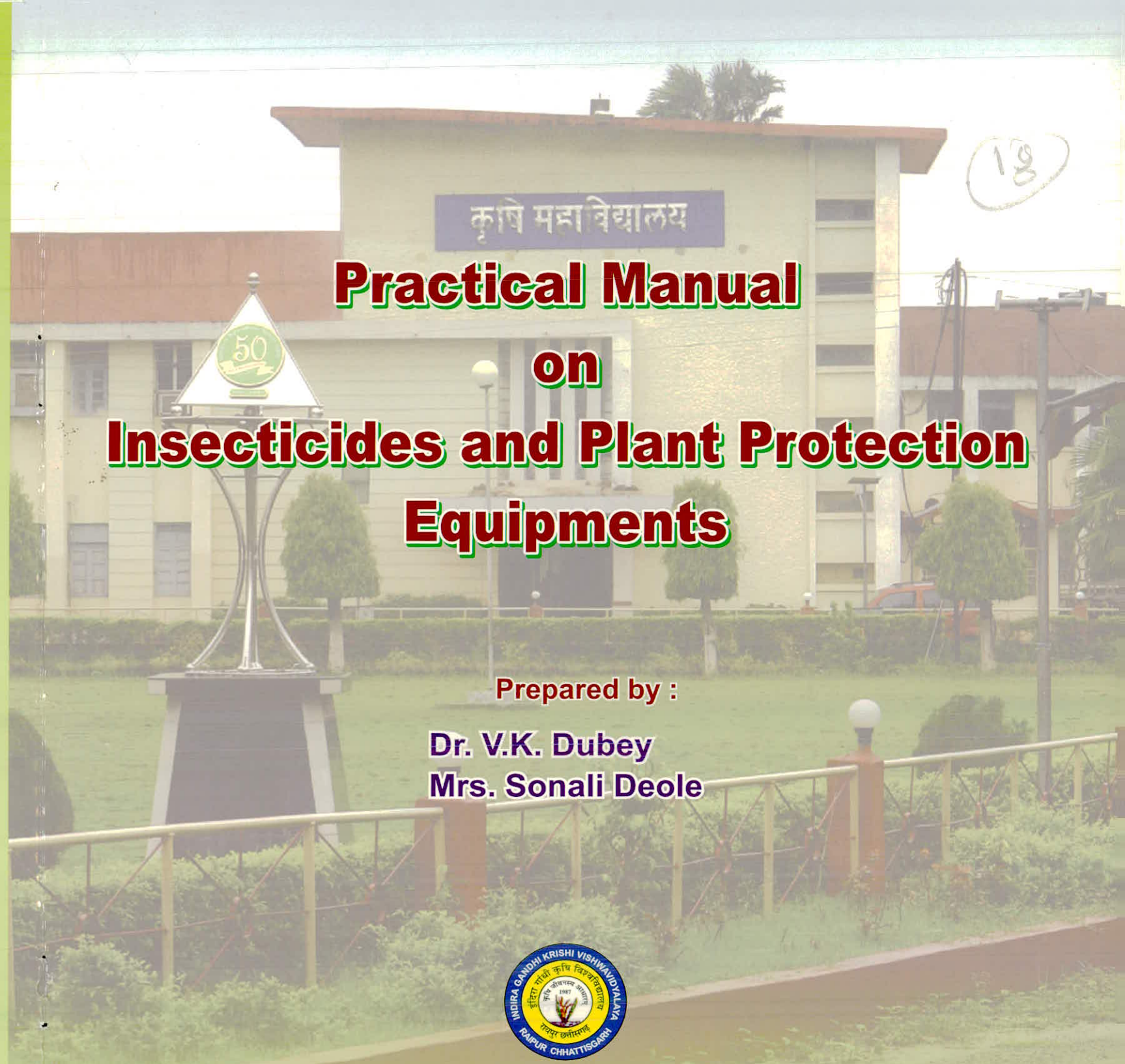

Practical Manual on Insecticides and Plant Protection Equipments

Prepared by :

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Date: Course Teacher

Content

Practical No. 1

Title : Practical Apprehension about Different Insecticide Formulations

Objective : To make acquainted about different insecticide formulations viz. dust, granules, liquid etc.

The mixture of active and inert ingredients is called a pesticide formulation or the preparation of the a.i. in a form suitable for use is referred to as formulation. Pesticide chemicals in their "raw" or unformulated state are not usually suitable for pest control. These concentrated chemicals and active ingredients may not mix well with water, and may be difficult to handle and transport.

Formulation of insecticide:- e.g.:- chlorpyriphos 20% EC

Chlorpyriphos tech.(based on 94%w/w a.i.)	-	21.5%w/w
Solvent –Aromax	-	72.5%w/w
Emulsifier-Anionic-alkyl aryl Sulphonate,non aionic-polyaxyethylene ether	-	6%w/w
TOTAL	-	100%

Composition of Formulation:-

A.) Active Ingredient (a.i.) - The actual chemical in the product mixture that controls the pest.

B.) Additive or Dilutent- Many type of additives are available, few of it can be understood:-

1. **Solvents:-** A solvent dissolves the active pesticide chemical, converting it from a solid to a liquid with the molecules of the pesticide. The solvent acts as both a carrier for the chemical and as a diluent. Some solvents, such as petroleum oils, also add the insecticidal properties to the solution.
2. **Emulsifiers:-** An emulsifier is a surface-active agent that stabilizes a mixture of a liquid within a liquid; the resultant liquid is called an emulsion. An emulsifier forms a tough film around each droplet of oil, which resists the tendency of the droplets to coalesce and, separate into continuous layers of oil and water. Detergents are usually used as emulsifiers.
3. **Spreading and 'wetting' agents**:- Spreading agents may be added to oil based insecticides to decrease the surface tension and cause the oil to spread as a thinner film on the water surface. Wetting agents aid in the formation of a continuous film of insecticide on water repellent surfaces, or increase the rate with which water soaks into or wets solid material.
4. **Synergists:-** Synergists are compounds which when added to insecticidal mixtures will increase the insecticidal toxicity so that the amount of insecticide needed can be decreased. For example, the addition of the relatively inexpensive synergist, piperonyl butoxide.

"THERE ARE 10 QUINTILLION (10^{18}) INSECTS ON THE EARTH MEANING FOR EVERY HUMAN BEING ABOUT 10,000 INSECTS ARE THERE"

Formulation Selection Considerations

1) Applicator safety:-Different formulations present various degrees of hazard to the applicator. Some products are easily inhaled, while others can penetrate skin or cause injury when splashed in the eyes.

2) Environmental concerns: - Special precautions need to be taken with formulations that are prone to drift in air or move off target into water.

3) Pest biology: - The growth habits and survival strategies of a pest will often determine what formulation provides optimum contact between the active ingredient and the pest.

4) Available equipment:- Some pesticide formulations require specialized handling equipment. This includes application equipment, safety equipment, and spill control equipment.

5) Cost:- Product prices may vary substantially, based on the ingredients used and the complexity of delivering active ingredients in specific formulations.

Forms of Insecticide

- Solid dry form.
- Liquid form.
- Gaseous form.

Solids	Liquids	Gases
Dust or powders, Granules, Pellets, tablets Particulates or Baits, Dry flowables, Wettable powders, Ear tag/ Vapour strips, Seed treatment WDGs	Suspensions Concentrate (Flowables), Solutions, Emulsifiable concentrates, Gels, Aerosol, Ultra low volume concentrates, Microemulsions.	Fumigants sold as liquids or solids

A. Formulations for Dusting:-

1. Dust:- Preparation:- Impregnating highly sorptive particles + solution of pesticide

Mixing

↓

Grinding with pesticide+ Diluent (In mill)

"THERE ARE OVER 1.5 MILLION INSECT SPECIES IDENTIFIED AND DOCUMENTED IN THE WORLD"

Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10 percent or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash.

Dusts are manufactured by the sorption of an active ingredient onto a finely-ground, solid inert such as talc, clay, or chalk.

Characteristics of diluents:- Diluents filler with high surface acidity & alkalinity & high oil absorption index should be avoided because this form unstable formulation.

Suitable diluent or carriers: - They are clay minerals like:-

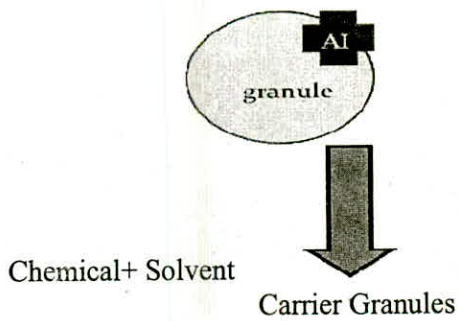
a) Attapulgite (Fallers Earth). B) Montmorillonite C) Kaolinite *D)* Forms Of Silica
E) Pure Silica F) Diatomite

Principal Uses:-

Because of drift, dusts are not recommended for large scale outside use. Outside they are used principally for spot treatments and home gardens.

They work best when applied to dewy domestic insects.

2. Granule:- Preparation: -



Choise of carrier:-

1). Softivity of materials. 2). Hardness. 3). Bulk density.
4). Free flowingness of materials. 5). Rate of disintegration (degradation) a granule in water

Carriers:- Catapulgite.Vermiculite, Coal Dust, Coarse Sand

e.g.:- Carbofuran 3G, Phorate10 G, Cartap hydrochloride 4G, Diazinon 5G, Dichlorvos 5G, Quinolphos 5G, Fipronil 0.3G,

Application:-

1). It is useful for hazardous material. 2). It can be applied as Spot treatment-Maize in funnel. 3). It is the easy method of handling of pesticide. 4). Less hazards to natural enemies.

"THE HIGHEST AVERAGE CONSUMPTION OF PESTICIDE IN THE WORLD IS IN TAIWAN (17 KG/HA) WHILE, IN INDIA IT IS ONLY 0.57 KG/HA"

Principal Uses:-

1. Granular pesticides are often used for soil treatments to control pests living at ground level or underground.
2. They may be used as soil systemics, that is, formulations applied to soil that are absorbed into the plant through the roots and carried throughout the plant.

3. Pellets and Chalk formulation:-

Most pellet formulations are very similar to granular formulations; the terms often are used interchangeably. In a pellet formulation, however, all the particles are of the same weight and shape. The uniformity of the particles allows use with precision through application equipment.

Product	Chemical Composition	A.I.
MAGIC	Cypermethrin	1.00% w/w
Premium chalk	methanol	10.00% w/w
	Calcined Gypsum	89.00% w/w
	Total	**100.00% w/w**

Effect of Magic premium chalk:-Ant, cockroach & other insect repellent.

4. Baits:- In baits a.i. is mixed with edible substance. These are always stomach poisons and are used for poison baiting, which is chiefly 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. There are two type of baits are available:-

a.) Dry baits:- Preparation:- Pesticide + Edible product/ Inert material (Attractive to pest)

The amount of active ingredient in most bait formulations is quite low, usually less than 5 percent.

e.g. some rodenticide:- Zinc phosphide 80% powder, Aluminium phosphide 3g (Tablet), Bromodiolone. Example:

1.) Cut worm,	Bran as bait.
2.) Cockroach	Banana bait
3.) Rat	Maize + Warfarin in wax blocks

b.) Liquid Baits:-

An increasing number of insecticides and rodenticides are being formulated as liquid baits. Liquid rodenticides are mixed with water and, placed in bait stations designed for these products. They have two major benefits. Liquid rodenticides are effective in controlling rodents, especially rats, in areas where they cannot find water.

"DDT WAS SYNTHESIZED BY OTHNER ZEIDLER IN 1874 BUT INSECTICIDAL PROPERTY WAS DISCOVERED IN 1939 BY PAUL MULLER."

They are also effective in areas of poor sanitation, where readily available food renders traditional baits ineffective. Liquid insecticide ant baits have a number of advantages. They are very effective against certain species of sugar-feeding ants.

Principal Uses:-Baits are used inside buildings for pests such as ants, roaches, flies, rats, and mice.

B.FORMULATION FOR APPLICATIONS AS SPRAY:-

1.) Wettable Powders (WP):- Wettable powders settle out quickly, therefore require constant agitation in the spray tank.

WP also called as dispersible or sprayable powders, it consists of:-

Finely divided pesticide particles + surface active agents. —Enable→ **in water** → **Stable homogenous-suspension.**

(Frequently contains 50% a.i. some times higher)

The upper limit determined by amount of inert materials synthetic silica (Hisil), it is particularly required to prevent the pesticides, of the a.i. fusing together during, processing in a hammer or fluid energy mill (microniser).

Ex:-Carbaryl 50 WP

Active ingredient:Carbaryl(1-naphthyl –N-methyl carbamate)	---	50%
Inert ingredients	---	50%
Total	---	100%

Other example:- Thiodicarb 75% WP, Propaxure 50%WP, Methomyl 90% WP, Decamethrin 2.5% WP.

Principal Uses:- Liquid concentrates and wettable powders are the formulations most widely used by commercial applicators. Like liquid concentrates, wettable powders can be used for most pest problems and in most spray machinery.

2. Soluble Powders (SP or WSP):-

Soluble powder formulations look like wettable powders. However, when mixed with water, soluble powders dissolve readily and form a true solution. After they are mixed thoroughly, no additional agitation is necessary. The amount of active ingredient in soluble powders ranges from 15 to 95 percent by weight; it usually is more than 50 percent.

EX:- Acephate 75 SP, Methomil 40 SP, Acetamiprid 20 SP, Chlordimeform 50 SP.

"HCH WAS SYNTHESISED IN THE YEAR 1825 BY MICHAEL FARADAY BUT ITS INSECTICIDAL PROPERTY DISCOVERED IN THE YEAR 1941 IN FRANCE"

1. **Water-Dispersible Granules (WDG) or Dry Flowables (DF):-**

This formulation appears as small pellets or granules. Water-dispersible granules, also known as dry flowables, are like wettable powders except instead of being dust like. Water-dispersible granules must be mixed with water to be applied. Once in water, the granules break apart into fine particles similar to wettable powders. The formulation requires constant agitation to keep them suspended in water. The percentage of active ingredient is high, often as much as 90 percent by weight.

Undiluted and diluted dry flowable formulation.

Ex:- Thiamethoxam 25 WDG, Pymetrozine 50 WDG, Indoxacarb 30 WDG.

4.) Emulsifiable Concentrate:-

Emulsifier an important component of formulation.

It is surface active agent which → Partly Hydrophilic
It is surface active agent which → Partly Lipophilic

Preparation: -

Pesticide + Suitable organic solvent (like xylene or cyclohexanone)

↓

It can be mixed with water

Forms two separate layers

Ex:- Profenophos 50EC, Malathion 50EC, Diazinon 20 EC, Fenitrothion 35EC, Quinolphos 25EC, Chlorpyriphos 20EC, Dimethoate 30EC.

By a mixture of surfactant stability of an emulsion is improved, and unstable emulsion breaks if disperse phase separates forms a cream on the surface. Agitation of the spray mix prevents creaming. Breaking of an emulsion after spray droplets reach the target due to evaporation of continuous phase (water).

Principal Uses:-

High concentrate liquids can be diluted and used in many ways on fruit, vegetables, shade trees, for residual sprays on farm animals, for structural pests.

5. Encapsulated Pesticide:-

Microcapsules of about 10 μm diameter made by phase separation process to contain a solution of a dye in oil within a hardened gelatin wall.

"PARATHION IS THE FIRST ORGANOPHOSPHATE INSECTICIDE SYNTHESIZED IN THE YEAR 1946."

Now, various types of polymers are being investigated, in addition- use & further the size of molecules have been reduced down to 3μm diameter. For the preparation of encapsulated formulation extra cost is added.

Ex:- Lambda-cyhalothrin.

6. Water-Soluble Packets (WSB or WSP):-

Water-soluble packets reduce the mixing and handling hazards of some highly toxic pesticides. Manufacturers package precise amounts of wettable powder or soluble powder formulations in a special type of plastic bag. When, these bags are dropped into a filled spray tank, they dissolve and release their contents to mix with the water. There are no risks of inhaling or contacting the undiluted pesticide as long as packets are not opened. Once mixed with water, however, pesticides packaged in water-soluble packets are no safer than other diluted pesticides.

7. 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.

e.g. Imidacloprid 50 SC, Indoxacarb 14.5 SC, Chlorfenapyr 3 SC, Spiromesifen 2 SC, Flubendiamide 480 SC.

8. Liquid Concentrate (L.C.):- It is a thick insecticidal liquid which is easily dissolved in water or other solvents.

e.g. nicotine sulphate 40 %-Its spray for aphid control in 1:1800 in water.

9. Flowables (F):- When, an active ingredient is insoluble in either water or organic solvents, a flowable formulation is developed. The toxicant is milled with a solid carrier, such as inert clay and subsequently 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.

e.g.;Methoxyfenozide(Intrepid 2F), Carbofuran 48F.

10. Solutions: - Many of the synthetic organic insecticides are water insoluble but soluble in organic solvents like amyl acetate, kerosene, xylene, pine oil, ethylene dichloride etc., which themselves possesses some insecticidal properties of their own. Some toxicants are dissolved in organic solvents and used directly for the control of household pests.

e.g. Baygon.

11. Insecticide Mixtures:- Insecticide mixtures involve combinations of two or more insecticides in the right concentration into a single spray solution. Pesticide mixtures may result in synergism or potentiation (enhanced efficacy) and the mitigation of resistance.

"ISOLAN IS THE FIRST CARBAMATE INSECTICIDE SYNTHESIZED IN THE YEAR 1951"

However, antagonism (reduction in efficacy) may also occur due to mixing of two (or more) pesticides together. Ex:-

1. Profenofos25% + Cypermethrin 5% EC
2. Profenofos10% + Cypermethrin 20% EC
3. Cypermethrin 20% + Permethrin 10% EC

C. Fumigants:-

Fumigants are liquids or solids that are active as a gas. Fumigants are pesticides in the form of poisonous gases that kill when absorbed or inhaled. Fumigants are poisonous gases which require no further formulation, but are used in the form provided by the manufacturer.

These are available as:-

1. Dry fumigants: - types of dry fumigant:-

a. **Dust:-** e.g, Calcium cyanide.

b. **Solid crystals:-** e.g, naphthalene para dichloro benzene.

c. **Tablet:-** e.g, Aluminium phosphide,it is available in small hard tablet and sachet form, which is with Ammonium carbonate on exposure to moisture, releases the fumigant phosphine, together with Aluminium hydroxide, Ammonia and CO_2.

2. Liquids:- e,g., Ethylene dibromide, methyle dibromide,

Methyl bromide ←——— Liquefied gases ←——— under pressure

3. Mixture:- Few chemicals are mixed together to use as fumigant.

e.g., Ethylene dibromide + carbon tetra chloride (EDCT) mixture.

Active as a poisonous gas, penetrates cracks, crevices, and stored commodities

Highly toxic to all living organisms

Very high risk of inhalation exposure

Fumigants are non-selective and highly toxic to a wide range of living organisms.

Principal Uses:-

Fumigants are used inside dwellings or other buildings to control vermin that cannot easily be reached by other pesticide formulations.

Stored grain pests are often controlled by fumigants.

Miscellaneous Liquid Formulations:-

1. Ultra Low Volume formulation (Concentrated insecticide liquids or Low volume concentrate (L.V.C.):-

These insecticides are sprayed with special type of sprayers and do not require mixing of water. These formulations are usually sprayed by the aeroplanes.

"PERMETHRIN IS THE FIRST PHOTO STABLE PYRETHROID DEVELOPED IN THE YEAR 1973"

Generally applied from high altitudes in extremely fine droplets without being diluted with water at ultra volume rates. There is greater residual toxicity and less loss through evaporation. Active ingredient ranges from 80-100 per cent.

Some ULV concentrate liquid formulations available in India are:-

1. Malathion-95% technically.
2. Phosphomidon- isopropyl alcohol (Dimecron-100SC)
3. Toxaphene (600gm) + DDT (300gm) per litre.

2. Fog Formulation:-

- In thermal fogging machine & oil emulsion of an insecticide is normally used.
- Kerosene or diesel oil as solvent if sludge is not formed.
- Flash point important to avoid the hot gases igniting the fog.
- W.P. formulations normally used with suitable carriers.
- Certain carrier based on Methylene chloride & a mixture containing Methanol.

3. Ready-to-Use- Low Concentration Solutions (RTU) Low-concentrate RTU formulations are ready to use and require no further dilution before application. They consist of a small amount of active ingredient (often 1 percent or less per unit volume) dissolved in an organic solvent. They usually do not stain fabrics nor have unpleasant odors. They are especially useful for structural and institutional pests and for household use. Major disadvantages of low-concentrate formulations include limited availability and high cost per unit of active ingredient.

E. Other formulations:-

1. SMOKES

Preparation:-

Pesticide + Oxidant + Combustible-material

(To generate a large- amount of hot gas)

Ex:- Sodium chlorate + Solid carbohydrate. (e.g. Sucrose) + Ammonium chloride (Retarding Agent)

⇓

Water vapour+CO_2 +CO (Small quantity)

Smoke generator should be designed in such a way:-

1. Avoid explosion.
2. Controlled rate of burning.

Eg:- 1.) Mosquito coils –Effect: - Deterrency, expellency, interference with host finding, bite-inhibitor, knock down & eventually death.

"IONIZING RADIATION INCLUDES GAMMA AND X-RAYS WHILE, NON IONIZING INCLUDES INFRARED AND MICROWAVE RADIATION"

Product	Chemical composition
1.Mortein coil (Household insecticide)	d-trrans Allethrin Wood flour Coconut shell powder Starch Binder genopol L088-emulsifier Red dye Fragrance Sodium Benzoate Potassium Nitrate Jiggat(Joss) Total
2.All Out (LIQUID- REFILL)	Prallethrin (Min. purity 90%) Stabilizer Butylated Hydroxy Toluence Perfume Solvent Deodorized Kerosene Total

2. Aerosols:- Aerosols (pressurized cans, "bug bombs") contain a small amount of pesticide, or a combination of pesticides that are driven through a fine opening by a chemically inactive gas under pressure, when the nozzle is triggered. Usually they are small, weighing about one pound.

Eg: Allethrin .Aerosols are sold mainly for garden and home use, not for agricultural use. Methoprene and Hydroprene are the examples of aerosols.

Ex:-

Product	Chemical Composition	A.I.
MORTEIN (NATURGARD)- MOSQUITO KILLER (With Natural Citronella Extracts).	Deltamethrin (Technical) Allethrin Dichloromethane Odour masking agent De-Odorised kerosene Propellant gas Total	0.02% w/w 0.13% w/w 0.15% w/w 0.15% w/w 39.55% w/w 60.00% w/w 100.00 % w/w

Principal Uses.

1. Aerosols are most often used in households, backyards, tents and other small areas.
2. They may be used either as space sprays for flying insects or as residual sprays.
3. Usually they are used against insects, but some are designed for plant diseases or weed killers.

"ELCAR (HNPV) REGISTERED FOR THE CONTROL OF BOLL WORM & TOABACCO ON COTTON IN 1975"

4. There are commercial models available for use in greenhouses, barns, etc.
5. These are larger models holding five to ten pounds of material, and are usually refillable.

Do as directed: Solid formulations

- Collect different types of solid formulation of insecticides.
- Sort out the solid formulations in to different categories viz; dust, granules, pellets, tablets.
- State about the bases of different categories.
- Observe these formulations for their various physical characteristics (using magnifications, if required)
- Understand and write about the peculiarities of different categories under, solid formulation especially with reference to their utilities.
- Understand the mode of translocation of these different categories of solid formulations and, correlate it with their site of applications on the crop.
- Study the speed of toxicant release in the granular form of insecticide at lab conditions.

Liquid formulations

- Bring different types of liquid formulations of insecticides.
- Understand different categories of insecticide formulation under liquid form.
- Take neem oil, mix it with water and, put in a glass tumbler or jar then observe for the descrete layer formulations, note down the time required for it.
- Now, in above solution mix teepol or detergent powder @1.0% after, thoroughly mixing it, observes for descrete layer formulations, note down the time required for it.
- Now take E.C.formulation of any insecticide, repeat the observations as described above.
- Compare all these three different situations, work out separately the shortcomings, if any.
- Take soluble powders (SP or WSP) and EC formulation of insecticides. Dissolve these separately (in fixed amounts) in glasses and compare for the Characteristics viz., solution formation, time setting, layer formation etc.

House hold insecticide formulations

- Collect and bring different house hold conditions insecticide formulations (HHCIF) utilized.

"METHOPRENE IS THE 1ST IGR (INSECT GROWTH REGULATOR) WHICH COMMERCIALLY USED IN USA IN 1975"

- Observe different forms of HHCIF, the a.i. present and the formulation details along with, manufactures name and target pest.
- Record about the peculiarities of the house hold formulations of insecticides viz., a.i. its group, strength etc.

Liquid formulation

- Take water of different pH, dissolve EC formulation of same insecticide in same quantity.
- Take periodical observations, for the setting behaviour and discrete layers formation with the time requirement.

"1ST BT PLANT DEVELOPED BY M. VAECK & CO-WORKERS OF BELGIAN BIOTECHNOLOGY COMPANY BY TRANSFERRING BT DELTA ENDOTOXIN GENE FOR *MANDUCA SEXTA*.

Practical No. 2

Title : Calibration of different insecticide formulations.
Objective : To work out the quantity of insecticide required for different given situations.

In laboratory and field situations, sometimes against the target insect pest, it is required to use an appropriate insecticide at recommended strength and dose to manage it. To work out the dose, concentration or quantity of toxicant, several points are needed to be kept in considerations.

Calibration

Calibration is a process of determining the exact quantity of insecticide required for spraying, dusting or spreading in a given area under the set up condition to manage the pest under ETL level.

Preparation of spray fluid- Insecticide

- Insecticide are available as 1-10% dust(D), 20-95% wettable power (WP) 20-100% water soluble concentrate (WSC), 1-10% granule (G) etc.
- Recommendation is given as quantity of formulated insecticide required / unit area, we can use as much.
- Recommendation is given as a.i./ unit area, we have to calculate actual quantity of insecticide required for per unit area.
- This can be calculated by two methods viz. Pearson's square method and using formulae.
- Before applying insecticide, it has to be diluted to required strengths.

Dilution depends on the crops height and type of sprayer.

A. Based on crop height :-

Crop height	Crop	Dust	Sprayer fluid required litre (for hand sprayer /ha)
Short plant	Paddy, groundnut cucurbits, potato, sweet potato	20-25 Kg/ha	500-600
Medium plant	Pulse, tomato, cotton brinjal, chillies	25-35 Kg/ha	600-700
Tall plant	Castor, sugarcane, sorghum	35-50 Kg/ha	800-1000

B. Based on type of sprayers:-

- High volume (hand operated) = above 200 litre/ha
- Low volume (power operated) = 5 - 200 litre/ha
- ULV = upto 5 litre/ha

"ZOONOSIS IS A PHENOMENON WHERE AN INSECT TRANSMITTED DISEASE OF AN ANIMAL SPECIES ENTERS A HUMAN POPULATION"

Example 1:- If an insecticide Chloropyriphos 20 EC is available, to prepare the solution of 500 ppm, how much quantity of insecticide will be required for 500 litre solution?

Solution:- if we mix 1 ml insecticide in one litre water, it will be 1000 ppm solution (standard). 20 EC means 20% a.i. in 100 ml insecticide formulation.

If 1 ml insecticide (100%) is mixed in1000ml water = 1000 ppm solution will be prepared

Then,1 ml insecticide (20% EC) '' = 1000 × 20 ÷100

= 200 ppm solution

200 ppm solution formed, if we mixed = 1ml insecticide(20 EC) in / litre water,

For, 500 ppm solution = 500/200

= 2.5 ml insecticide/litre water

For, 500 litre solution of insecticide = 2.5 ×500 =1250 ml insecticide needed.

Example 2. 50 ppm solution of 5 litre volume has to be prepared, using Nuvacron 36EC work out and state about the followings;-

Prepare steps of it.

Total quantity of insecticide required,

Maintain step for 10 ppm solution.

Solution:- If 1 ml insecticide (100%) is mixed 1000ml water =1000ppm solution prepared

Then, 1 ml insecticide (36%) '' = 1000 × 36 ÷100

= 360 ppm solution

360 ppm solution formed, if we mixed = 1ml insecticide/litre water,

50 ppm solution = 50/360

= 0.139 ml insecticide/litre water

For, 5 litre solution of insecticide = 0.139 ×5 =0.69 ml insecticide,

Preparation of 10 ppm insecticide solution;

360ppm formed when we mixed = 1ml insecticide/litre of water,

10 ppm '' =10÷360 = 0.0277 ml insecticide/litre of water.

Example 3. In a field of paddy, fipronil 0.6% G has to be applied @ 80g a.i./ha. Calculate the dose of formulation required in kg per hectare.

Solution: - In 100g formulation there is only 0.6 gm a.i. is present

Therefore, in 1000g (1kg) formulation = 0.6 × 100 ÷1000 =6.0 g a.i.

6g a.i. is present in = 1000g formulation

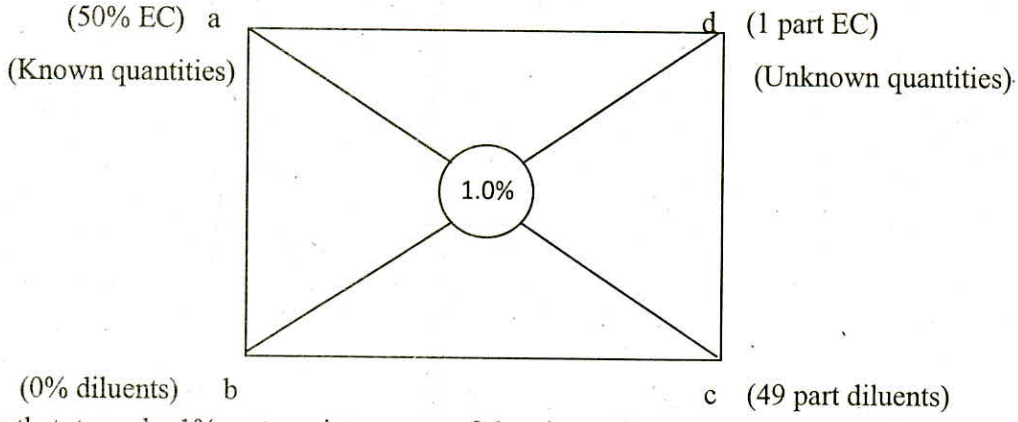
Therefore, 80g a.i. '' = 1000 × 6 ÷100 =13333.33 =13.33kg / ha.

"Arsenic compound was used in USA to check the spread of Colorado beetle by 1900 led to introduction of 1st Pesticide legislation in the world"

PEARSON METHOD

Example:- To prepare 1 percent mixture from a given 50 percent Malathion EC.

Solution:- Make a square abcd. Keep the known strength of the EC and, the diluents at points a and b of square (strength of the diluents, whether water or a carrier is regarded as 0 percent), and the desired strength (1 percent here) in middle of the square. Now, to get the required quantities of EC and diluents subtract the smaller figure from the higher ones (i.e., 1-0=1, 50-1=49).



This means that, to make 1% water mixture, out of the given 50% EC, we required 1 part of EC + 49 part of diluents (water). This calculation can be verified by back calculation as follows:-

49 parts diluents + 1 part EC make 50 parts of the mixture. Since, the given EC is 50 percent in strength. Therefore, 1 part of the EC, in the present case will contain only 0.5 (50 percent of a.i.) part of the active ingredient.

Thus, to get the percent strength, 50 parts of mixture contain 0.5 part of active ingredient.

100 parts of mixture contain = $0.5 \times 100 \div 50$ =1% which was the desired strength.

Formula method: using formulae for EC and WP formulations

$$N_1 V_1 = N_2 V_2$$

Here, N_1 = concentration of given formulation (%)

V_1 = volume / amount of formulation required (ml or g)

N_2 = concentration of spray fluid required (%)

V_2 = volume / amount of spray fluid required (ml or g)

$$V_1 = N_2 V_2 / N_1$$

IN CASE OF GRANULES AND DUST FORMULATIONS

$$N_1 V_1 = 100 R A$$

Here, N_1 = concentration of given formulation (%)

V_1 = volume / amount of formulation required (g or kg)

R = recommended rate of pesticide application (g or kg a.i. / ha)

A = area to be treated (ha)

$$V_1 = 100 R A / N_1$$

"RACHEL CARSON PUBLISHED A BOOK "SILENT SPRING" IN 1962, DEPICTING THE ILL EFFECTS ON THE ENVIROMENT DUE TO EXCESSIVE USE OF DDT"

Example: A paddy farmer, was advised to spray 0.05% Chlorpyriphos (20% EC), for the control of rice leaf roller in his 4 acres of cropped area. Calculate the cost of the chemical, when the spray fluid required is 300lt./acre while, the cost of the chemical is Rs. 500/lt.

Solution:- here given N_1=20 %, N_2= 0.05%, V_1= ?, V_2=300 litre

Quantity of chemical required per acre (V_1) = $N_2 \times V_2 \div N_1$ = $0.05 \times 300 \div 20 = 0.75$ litre

For 4 acres = 0.75 x 4 = 3 litre

Cost of the chemical = 3 x 500 = Rs.1500/-

Example:- For the control of groundnut leaf miner, a farmer has mixed 750ml of Chlorpyriphos 20 EC, in 300 litre of water and sprayed in his field. Find out the concentration of spray fluid he has applied in his field.

Solution:- here given N_1=20 %, N_2= ?, V_1= 750ml or 0.3litre, V_2=300 litre.

Three hundred (300) ml of Chlorpyriphos 20% EC is added to 750 litres of water.

The strength/concentration of Chlorpyriphos in the spray liquid is (N_2)= $N_1 \times V_1 \div V_2$ = $20 \times 0.75 \div 300 = 0.05\%$

Sprayer Calibration

If and when, it becom necessary to apply pesticides, it is likely that application will be made with a pump-type backpack sprayer. These sprayers are relatively inexpensive, simple, and easy to operate. The rate of spraying depends on four major factors:

1) Pressure in the spray tank.
2) Size of nozzle orifice.
3) Spray swath.
4) Walking speed of Spray person

When, calibrating a sprayer, it is important to keep in mind that, the calibration will be valid only for that Particular sprayer in that Particular swamp with that particular spray-Person, since a change in any one of these variables, will affect a change in the rate of spraying.

To calibrate a sprayer, follow these procedures

1. Prepare sprayer
   a) Rinse supply tank and fill with clean water.
   b) Remove nozzle; check and clean, if necessary.
   c) Flush pump, hose, and lance with clean water.
   d) Apply pressure (i.e. pump) and check sprayer for leaks.

"REPRODUCTIVE STIMULATION BY SUBLETHAL DOSES OF PESTICIDES IS KNOWN AS HORMOLIGOSIS, WHILE PHYSICAL BIRTH DEFORMITIES IN UNBORN ANIMALS, FOLLOWING EXPOSURE OF PREGNANT FEMALES IS CALLED TERATOGENIC"

2. Determine walking speed of spray person

a) Fill tank with clean water.

b) In an actual paddy, mark starting point with a stake.

c) Using your wristwatch, begin one minute trial. Walk at a constant and normal speed, carrying the filled sprayer on your back. Pump the sprayer handle with one hand to maintain pressure and direct the nozzle with the other hand to obtain a spray swath of approximately 1m width.

d) Stop walking at the end of exactly 1 minute and mark the stopping point, with a second stake.

e) Measure the distance between the starting and stopping points. Record the distance in meters. Walking speed can be expressed in terms of m/minute.

f) Repeat trial at least three times to obtain an average walking speed.

3. Calculate area sprayed in one minute

If the spray swath was kept at (approximately) 1m, the area sprayed in one minute can be calculated easily using the known walking speed:

Area sprayed in one minute = spray swath (1m) x walking speed (m/minute). The answer is expressed in terms of m2/minute.

4. Determine nozzle discharge in one minute

a) Fill sprayer with clean water and pump sprayer handle to build up pressure.

b) Dip end of nozzle into a graduated cylinder.

c) Using your wristwatch, begin 1 minute trial. Open the cut-off valve and spray into the graduated cylinder. Make sure none of the spray escapes.

d) Cut off the discharge at the end of exactly 1 minute.

e) Note the volume in litres of liquid collected. This is the nozzle discharge, expressed in terms of litres/minute (1/min).

f) Repeat trial at least three times, to obtain an average nozzle discharge.

g) Now, you can easily compute the rate of spraying

h) Rate of spraying = (nozzle discharge (1/min)) / (area sprayed (m2/min))

i) (1/m2)

j) Since most pesticide application rates are given in terms of 1/ha, the rate of spraying should be converted to the same units of measurement

k) Rate of spraying = 1/m2 x 10000m2/1 ha = 1/1 ha

i.e., simply multiply the rate calibrated for 1/m2 x 10000.

"PAUL DEBACH PUBLISHED A BOOK "BIO-CONTROL OF INSECT PEST AND WEEDS" WHICH ESTABLISHED BIOCONTROL AS A SEPARATE DISCIPLINE IN ENTOMOLOGY"

Do as Directed

In a field situation, work out the following information with the help of plant protection equipments, insecticide and diluents.

- The total volume of spray required to cover one hectare area of the crop.
- Diluents requirements at the different growth stages of the crop on per hectare basis.
- Differences in the spray area coverage by different spray persons.
- Calculate the spray swath covered by the sprayer at different pressure levels.
- Mark the differences in the amount of insecticide solutions required as per:
- The spray persons.
- Equipments in use.
- Crop growth stages.

"HERBICIDES ARE MOST EFFECTIVE WHEN APPLIED AS DROPLETS OF 250 MICRONS, FUNGICIDES AT 100-150 MICRONS AND INSECTICIDES AT ABOUT 100 MICRONS"

Practical No.3

Title : Work out the relative efficacy of Insecticides

Objective : To categorize the different insecticides as per their relative efficacy.

In agricultural operations sometimes, it needs to understand that out of several insecticide molecules, which one is the best against the given target insect pest and situations, for which the comparative efficacy of insecticides is required to work out.

The following steps are done for such particular objective under the study.

- Ascertain the problem of an insect pest on a given crop.
- Collect the number of insecticide molecules, which are to be tested against the target insect pest.
- Assure that the relative efficacy of insecticides to be worked out for which, situation i.e. in laboratory condition or field condition.
- For field situation the crop should have been raised as per the appropriate design viz., RBD, factorial RBD, LSD, strip plot design etc.
- The number of experimental plots, under each replication, has to be decided as per the number of treatments (Insecticides),with one additional plot as control (No spray of insecticide).
- The size of the plot spacing and, other agricultural practices, should be done, following the standard agronomical practices.
- There should be sufficient number of replications (repetition) of the treatments.
- Now, the observations for the target insect pest should be done, at the appropriate stage of the crop.
- Record the ETL of the target insect pest and, assure the level has reached (pretreatment observation).
- Now, assign insecticides to different plot numbers and fix it.
- Apply the insecticides at the recommended doses and manner.
- Twenty four hours after application of the insecticides, record the population density of the target insect pest.
- Repeat the observation for the population density of target insect pest, on 3, 7 and 14 days after application of insecticides.
- Insect population density has to be recorded, on 5 or 10 plants per plot basis or as per the nature of infestation of target insect pest.

"FLEAS ARE WELL KNOWN AS PESTS OF DOMESTIC ANIMALS AND MAN. ONE SPECIES TRANSMITS THE BACTERIUM THAT CAUSES PLAGUE. PLAGUE HAS KILLED MORE THAN 125,000,000 PEOPLE OVER THE PAST 3,000 YEARS"

- Now, compile the data treatment wise, replication wise and average it.
- Before proceeding for the statistical analysis of the data appropriate transformation of the data should be done, if it is required.
- Now, the observed data set should be analysed following the appropriate statistical design viz. CRD, RBD, LSD etc.
- Get the calculated F value, compare it against the table F value, if it is significant then compute CD (Critical Difference).
- Compute the differences between different treatments averages and, then compare it against the worked out CD (Critical Difference) value.
- Observe that the insecticide allowing the least population density of the target insect is the most effective, as compared to any other insecticide tested.

Ex:- Efficacy of different insecticides for the control of gram pod-borer.

Chemical	Dosage	Mean no. of larvae before treatment	Mean no. of live larvae after treatment (days)		
			2	5	10
Carbaryl 5 D	25 kg/ha	3.24 (1.79)	0.82 (1.13)	0.00 (0.70)	0.00 (0.70)
Endosulfan 4 D	25 kg/ha	3.15 (1.76)	0.66 (1.06)	0.49 (0.97)	0.08 (0.75)
Methyl parathion (2% dust)	25 kg/ha	3.15 (1.74)	1.41 (1.35)	0.57 (1.02)	0.24 (0.85)
Monocrotophos 36 SL	0.04%	3.15 (1.77)	0.41 (0.93)	0.33 (0.89)	0.08 (0.75)
Fenvalerate 20 EC	0.01%	3.32 (1.81)	0.24 (0.84)	0.41 (0.95)	0.00 (0.70)
Alphamethrin 10 EC	0.01%	3.57 (1.88)	0.74 (1.10)	0.16 (0.80)	0.08 (0.75)
Neem oil	3%	3.32 (1.81)	0.99 (1.21)	0.57 (1.03)	0.24 (0.75)
Control	-	3.24 (1.79)	2.24 (1.64)	2.57 (1.74)	1.32 (1.33)
C.D. 5%		NS	0.181	0.178	0.114

Mean of four replications, Figures in parentheses are ✓X+0.5 transformed values.

"THE FIRST INSECT GROWTH REGULATOR REGISTERED BY EPA AS A CONVENTIONAL CHEMICAL PESTICIDE IN THE YEAR 1975 IS METHOPRENE WHICH IS A JUVENILE HORMONE ANALOGUE"

Practical No.4

Title : Understanding the basic principles about the compatibility of pesticide mixtures

Objective : Understanding about the mixing possibilities of different pesticides.

Mixing of pesticides saves time, labour, energy and equipment costs. It is often economical and convenient, to apply a mixture of two or more pesticides, when a wide range of pests must be controlled. In most instances, the pesticide user must add separate products to the spray tank. These products must be compatible with each other.

The possible effects of mixing incompatible chemicals are many and include:

- Reduced effectiveness of one or both compounds.
- Precipitation in the tank, clogging screens and nozzles in the sprayer.
- Plant phytotoxicity, stunting or reducing seed germination.
- Excessive residues.
- Excessive runoff.

There are basically three types of interactions that change the efficacy of pesticide combinations.

1. **Additive effects:** Occurs when mixing two pesticides and provides the same response as the combined effects of each material when applied alone. The products neither hurt nor enhance each other. Such mixes save time, labour and equipment use.
2. **Synergistic responses:** Occurs when two pesticides provide a greater response than the added effects of each material when applied separately. Unlike additive effects, the chemicals in a synergistic combination are not neutral towards each other. Rather, they interact in some way that increases their effect and may increase control. With true synergism, one can often reduce pesticide application rates without sacrificing control.
3. **Antagonism:** When two pesticides applied together produce less control than if each material is applied separately is called antagonism. In addition to reducing control, antagonistic responses also may increase phytotoxicity.

Label Information

The label on many pesticide products contains a list of compatible pesticides. Some labels even contain directions for mixing the product with certain other pesticides. Compatibility charts are available. However, there is still need for caution. In addition, factors such as type or variety of crop, weather and water chemistry (especially pH) may be important. Recommendations, labels and compatibility charts are certainly helpful but the pesticide user should take additional precautions.

"SCORPION FLIES ARE HARMLESS, BUT ARE SO NAMED BECAUSE SOME OF THE MALES HAVE THE END OF THE ABDOMEN ENLARGED WHICH MAKES IT LOOK LIKE THE STINGER OF A SCORPION"

Tank Mixing

When attempting pesticide combinations that are unfamiliar, a jar test should be done to check for incompatibility. In addition, the combination must be tested on a few plants or a small area before larger-scale treatments. Also, 2 to 3 days waiting is necessary for any problems to become apparent. Finally accurate records on compatible, safe combinations should be kept for future reference.

Jar Test for Compatibility of Pesticide Mixtures

For all unlabelled tank mixtures, a jar test is strongly recommended to test for compatibility as given:

Step1. Measure approx. 500ml of water into a clear one litre jar. The same water (or other diluent) that will be used when making up the larger mixture should be taken.

Step2. Add ingredients in the following order. Stir each time a formulation has been added.

- ❖ Compatibility agents and activators
- ❖ Wettable Powders and Dry Flowables.
- ❖ Water soluble concentrates or solutions.
- ❖ Emulsifiable concentrates.
- ❖ Soluble powders.
- ❖ Remaining adjuvants and surfactants.

Amount of pesticide to be added for a compatibility test

Pesticide Formulation	Rate/Acre	Teaspoons to
Wettable powders or Dry flowables	453.5 g	1.5
	907.0 g	3.0
	1360.5Q	4.5
	1814.0 g	
Emulsifiable concentrates, Flowables,	0.567 I	0.5
Liquids, or Solubles	1.1341	1.0
	2.268 1	2.0
	4.536 1	4.0

Step 3. After mixing, let the solution stand for 15 minutes. Stir well and observe the results. Feel the sides of the jar to determine, if the mixture is giving off heat. If so, the mixture may be undergoing a chemical reaction and the pesticides should not be combined. Let the mixture stand for about, 15 minutes and feel again for unusual heat.

"THE FUNGUS, *VERTICILLIUM LECANII* IS BOTH ACARICIDE AND INSECTICIDE WHICH IS WELL DOCUMENTED PATHOGEN OF THRIPS, WHITEFLY AND SCALE INSECTS"

If scum forms on the surface, if the mixture clumps, or if any solids settle to the bottom (except for wettable powders), the mixture probably is not compatible. Finally, if no signs of incompatibility appear, test the mixture on a small area of the surface where it is to be applied.

Tank Mixing Guidelines

- Read the label. This is the first step when considering tank-mixes.
- Perform a jar test with any new mixes.
- Test pH many incompatibilities result from excessively alkaline (sometimes acidic) pH in the tank. The addition of buttering, adjuvants can help.
- Make a test application to expose any phytotoxicity or antagonism before making a large-scale application. Wait a few days for symptoms to become visible.
- Take care with fertilizers. If fertilizers are to be added, be aware that they can have substantial effects on the chemistry of a tank mix, especially pH. Read the pesticide label for any fertilizer restrictions.
- Do not mix iron sulfate with phenoxy herbicides. Iron sulfate is incompatible with amine formulations of some phenoxy herbicides and can cause a precipitate to form, clogging spray equipment.
- Mix no more than one soluble or emulsifiable chemical with any insoluble products such as wettable powders or flowables.
- Avoid mixing strongly acid materials with strongly alkaline materials.
- Apply sprays soon after mixing. Mixes that sit for several hours or longer are prone to degrade, especially if the pH is alkaline.

Proper Mixing Procedures

- Mixing Order: Pesticide labels usually provide directions for mixing different materials, often describing the sequence of mixing. Whenever a label provides such directions, one should follow them. In general, follow the W-A-l-E-S plan when adding herbicides to a tank mix.
  1. Wettable Powders (WP) then Flowables (F, DF)
  2. Agitate then add adjuvants such as anti-foaming compounds, buffers
  3. Liquid and Soluble products
  4. Emulsifiable concentrates (EC)
  5. Surfactants

"THE SHARE OF MICROBIAL PESTICIDES IN THE TOTAL WORLD PESTICIDE MARKET IS APPROXIMATELY 1-2 PERCENT"

Prior to mixing, fill spray tank with half of the carrier intended to use, usually water. Then, start the sprayer and check, to make sure that all valves and gauges work and also proper tank agitation has to be assured.

NOTE: Compatibility agents are adjuvants, that reduce the risk of incompatibility in pesticide or pesticide/fertilizer combinations. If compatibility agent is used, it should be the first thing to be put in the tank.

- Pre-mixing. Pre-mixing in a smaller, separate container or tank is necessary for many pesticide formulations.
- Wettable powders (WP). Make a slurry in a separate container, by adding small increments of water, until it forms a gravy-like consistency. Slowly, add this slurry to the tank with the spray tank agitator running.
- Dry flowable (DF) and water-dispersing granules (WDG). Pre-mix with 1 part flowable to 1 part water (start with the water and add the flowable to it) and then pour the mix slowly into the tank.
- Liquid flowables. Premix liquid flowables, by adding 1 part liquid chemical, to 2 parts water (or liquid fertilizer) before blending in the tank. Many labels, for liquid-flowable products, describe the proper mixing procedure.

"IN NEUROPTERANS SILK IS PRODUCED BY MALPIGHIAN TUBULES (EXCRETORY ORGANS) AND SPUN FROM THE ANUS"

Practical No.5

Title : Practical understanding of different equipments used for insect pest management.

Objective : To be acquainted about the structures of different plant protection equipments and their functioning.

Major categories of Plant Protection equipments:

- Dusting equipment - used for the dispersal of insecticide in powder form.
- Spraying equipment - used for the dispersal of insecticide in liquid form.
- Both dusters and sprayers are available in manually operated and power operated tools.

Duster

(A)Manually operated

(i) Package dusters

- In some pesticide dusts are packed in containers that serve as hand applicators and may be discarded after use.
- They are mostly provided with rubber, leather or plastic section which, on getting squeezed, provides a puff of air that emits the dust in a small cloud.
- The simplest type of package duster is worked by pressing it between the fingers.

(ii) Plunger dusters

- The consists of an air pump of the simple plunger type, a dust chamber, and a discharge assembly consisting of a straight tube or a small exit pipe whose discharge outlet can be increased or decreased by moving a lid provided at the end of the dust chamber.
- The air from the pump is directed through a tube into the container, where it agitates the dust and, eject it from a discharge orifice or tube.
- These are useful for spot application in restricted areas and for controlling ants, poultry pest and pest of farm animals.
- This operates on the piston principle, by generating an air blast, which passes through the dust chamber and expels the dust through the discharge outlet.

(iii) Bellow duster

- Its bellow made from rubber, leather or plastic.
- On squeezing, it puffs the air that expels the dust in a small cloud.
- Hand held bellow duster has containers of capacity from 30 g to 500 g.

"THE INSECTICIDE ACT WAS PASSED BY PARLIAMENT IN 1968, WHICH WAS ENFORCED THROUGHOUT COUNTRY IN AUGUST 1971, AND THE RULES WERE FRAMED, THERE UNDER IN OCTOBER, 1971 INSECTICIDE ACT OF 1968, IS REPLACED BY PESTICIDE MANAGEMENT BILL, 2008"

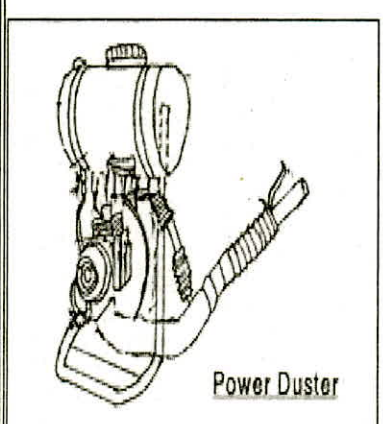
- The bellows can be operated either directly by hand or by handle provided for that purpose.
- The air blast developed by the bellow draws the dust from the hopper and discharges through the delivery system intermittently.

(iv) Hand Rotary or fan duster

- A consists basically of a blower complete with a gear box and a hopper. It is operated by rotating the crank.
- The cranking motion is transmitted through the gear box to the blower.
- A drive is taken for the dust agitator located in the hopper.
- The rotary duster may be hand carried type or shoulder mounted or belly carried type.
- The feed is controlled by a feed control lever, which operates a slide to control the aperture at the bottom of the hopper. Rotary dusters are provided with an agitator, which stirs the powder and, releases it evenly through the discharge vent.
- The blower sucks the dust or powder from the hopper through the connecting pipe, and pushes it out forcefully to achieve efficient dispersal.

(B) Power operated duster

(i) **Power dusters**



- It resembles the rotary duster in construction, except that the power to drive the blower through the gear box is tapped from an external power source, which may be an engine or P.T.O. shaft of the tractor or flywheel of the power tiller.
- The power operated centrifugal energy knapsack sprayer also can be converted into a power duster, by allowing the dust fluid into the air stream, near the point of attaching the pleated hose, in the blower elbow.

(ii) Rotary type duster

- *Here the air is sucked in by a motorized blower and discharged through the blower outlet.*

"THE FIRST REPORT OF INSECTICIDE RESITANCE IN INDIA WAS REPORTED IN SINGHARA BEETLE, *GALERUCELLA BIRMANICA* AT DELHI TO HCH AND DDT IN 1963"

(iii) **Air Jet Type duster**

- A jet air from the blower enters the hopper, which agitates the dust and blows it out simultaneously with a jet of air.

(iv) Aircraft and Helicopters duster

- Aircraft spraying is used generally in the control of mosquito and other forest insect.
- A small fixed winged aircraft was used for this purpose. Helicopters are more advantageous due to slow speed and lower height.
- Discharge rate may range from 0.5-25kg of dust per acre.
- The choice of aircraft should depend on operational circumstances.
- The under mention traits should be incorporated into an aircraft:
    (i) Ability to carry the insecticides load of at least 35.40 % of its gross weight.
    (ii) Minimum speed should be 45 mph. and maximum should be 60-100 mph.
    (iii) Simplicity in maintenance and repair.

(B) Sprayers

The Sprayer is one which, atomises the spray fluid (which may be a suspension, an emulsion or a solution) into a small droplets and eject it with little force for distributing it properly.

It also regulates the amount of pesticide, to avoid excessive application that might prove wasteful or harmful.

Types of sprayers

Sprayers are classified into four categories on the basis of energy employed to atomise and eject the spray fluid as

i. Hydraulic energy sprayer
ii. Gaseous energy sprayer
iii. Centrifugal energy sprayer and,
iv. Kinetic energy sprayer
v. Hydraulic energy sprayer

Hydraulic Energy Sprayer is one, which the spray fluid is pressurized either directly by using a positive displacement pump, or by using an air pump to build the air pressure above the spray fluid in the air tight container.

The pressurized fluid is then forced through the spray lance, which controls the spray quantity and pattern.

"IN GLOW WORMS (LAMPYRIDAE) (FIREFLIES) THE ENZYME LUCIFERASE ACTS ON THE LUCIFERIN, IN THE PRESENCE OF MAGNESIUM IONS, ATP AND OXYGEN TO PRODUCE LIGHT."

Gaseous energy sprayer

In Gaseous Energy Sprayer, high velocity air stream is generated by a blower and, directed through a pipe at the end of which, the spray fluid will be allowed to trickle by the action of gravity through a diffuser plate.

Centrifugal energy sprayer

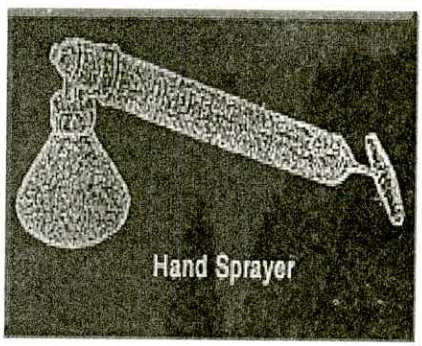
- In the Centrifugal Energy Sprayer, the spray fluid fed under low pressure at the centre of a high speed rotating device, (Such as flat, concave or convex disc a wire mesh cage or bucket, a perforate sieve or cylinder or a brush) is atomised by centrifugal force, as it leaves the periphery of the atomiser.
- The droplets are carried by the air stream, generated by the blower of the sprayer or by the prevailing wind, if the sprayer is not provided with a fan.

Kinetic energy sprayer

- In Kinetic Energy Sprayer, the spray fluid flows by gravity to a vibrating or oscillating nozzle, which produces a coarse fan shaped spray pattern.
- This is used for application of herbicides.

(A) Manually Operated sprayer

(i) Hand sprayer

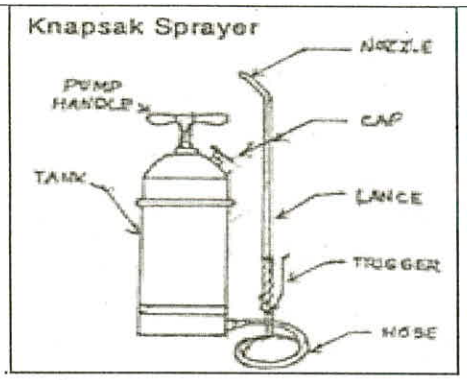


- The hand sprayer is a small, light and compact unit.
- The capacity of the container varies from 500 to 1000 ml.
- This is generally used for spraying small areas, like kitchen garden and experimental laboratory plots.
- It is a hydraulic energy sprayer.
- It has a hydraulic pump inside the container, with cylinder, plunger and a plunger rod.

(ii) Knapsack sprayers

- The tank is non-pressurised and made of plastic. The pump may be fitted into or outside the tank, and sucks the liquid from the tank and expels it through the discharge line.
- A spray boom or rig may be attached when wider areas have to be covered. The knapsack sprayer develops 30 – 40 psi pressure.

"JUVENILE HORMONES ARE THIRD GENERATION INSECTICIDES WHILE ANTI JUVENILE HORMONES ARE FOURTH GENERATION INSECTICIDES"

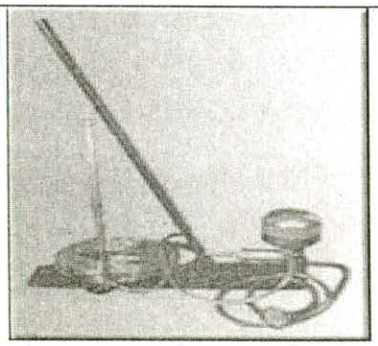


- Any sprayer which is carried on the back of the operator, is called a knapsack sprayer.
- The commonly used manually operated knapsack sprayer, will have one hydraulic pump working inside the container.
- The plunger works inside the replacement, well attached at the bottom of the container, for easier maintenance.

- The pump can be operated, through the appropriate linkages by oscillating the handle, with the sprayer carried on the back.
- An agitator, is also provided with the pressure chamber to agitate the fluid, so that the particles in suspension will not be allowed to settle down.
- A delivery tube, is attached on the other end of the pump, which carries the pressurized fluid to the spray lance.
- The flow to the nozzle is controlled by a trigger cut-off valve.
- In the case of compression knapsack sprayer, an air pump is used to build air pressure above the free surface of the spray fluid, in the container and, normally the pumping of the air will be done by, keeping the unit on ground and then sprayed til the air pressure comes down.

Rocker sprayer

- Operating on the same principle as the foot operated sprayer, this model is different only in as much as the plunger is operated by means of a lever that is pushed by hand.
- The pressure vessel is detachable. The options of two lines are available.
- The rocking sprayer has a pump assembly, fixed on a wooden platform with an operating lever, a valve assembly with two ball valves, a pressure chamber, suction hose with strainer, and delivery hose with spray lance.



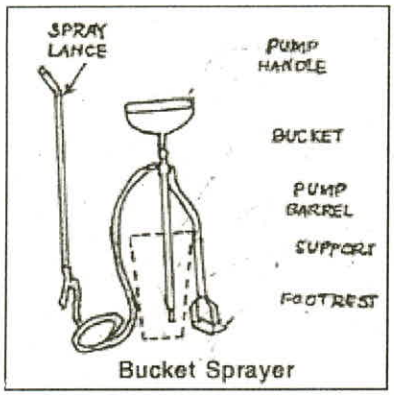
- When the plunger is pulled behind, by pulling the lever way from the pump, the spray fluid from the container is sucked, through the strainer and, pushes the bottom ball valve above and enters the pump.
- The movement of the lower ball valve is arrested by the upper valve seat.

"FIRE FLY ARE TINY WASPS (FAMILY MYMARIDAE) *DICOPOMORPHA ECHMEPTERYGIS* A COSTA RICAN SP. MALES ARE ONLY 0.139MM LENGTH EVEN SMALLER THAN A SINGLE CELLED PARAMECIUM."

- The operation is continued till the entire suction pipe, ball valve assembly, delivery hose and a portion of pressure vessel is filled with spray fluid and, the pump operator finds it difficult, to push the piston forward, due to the downward pressure developed by the entrapped compressed air in the pressure vessel.
- Thereafter, the trigger cut off valve will be opened, to allow the spray fluid to rush through the nozzle and get atomized.
- Usually, 14 to 18 kg/cm2 or 60 – 80 psi pressure, can be built in the pressure chamber and hence can be conveniently used for free spraying.

(iv) Bucket sprayers

- In the single barrel type the plunger is hollow and acts as a pressure chamber.
- In the double barrel variety, one barrel is of smaller diameter than the other and acts as a pump, while the bigger barrel serves as a pressure chamber, to produce more continuous spraying.
- The bucket sprayer is designed to pump the spray fluid directly from, the open container, usually a bucket.



Bucket Sprayer

- The hydraulic pump will be put inside the bucket and held properly, with the help of foot rest.
- As the plunger is pulled up, the fluid enters through the suction ball valve assembly and, when the plunger is pressed down, the suction valve closes and the fluid enters the pressure chamber through a ball valve assembly.
- As the plunger is continuously worked, pressure is built in the pressure chamber and the delivery hose.
- As soon as the required pressure is built up, the spraying will be done.

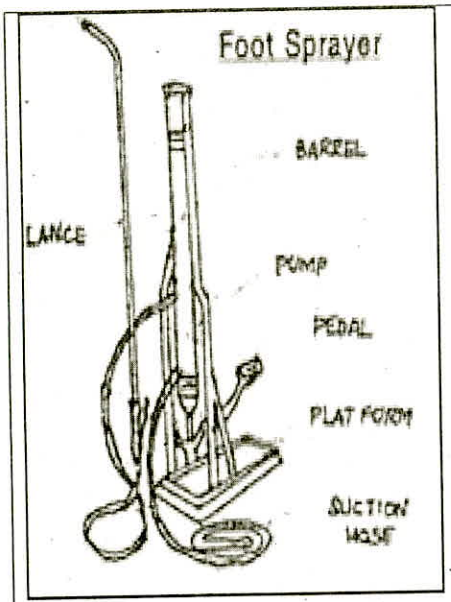
A pressure of 30 – 40 psi is developed in most of the models.

(v) Foot operated sprayers

- The pump in the foot sprayer consists of a pump barrel and a pressure chamber.
- The plunger with a suction cup or piston drives into the pump barrel, thus sucking the liquid into the pressure chamber and expelling it, through the discharge line.

"IN MOST OF THE INSECTS THE PRIMITIVE NUMBER OF ABDOMINAL SEGMENTS IS 11 AND A SMALL TERMINAL TELSON, EXCEPT IN COLLEMBOLANS WHICH POSSES 6 SEGMENTED ABDOMEN"

- The return stroke of the plunger pulls the liquid in, through the suction hose for the next discharge.



- This is a modified version of rocker sprayer.
- The plunger moves up and down when operated by the pedal.
- A ball valve is provided in the plunger assembly itself, to allow the fluid to cross the plunger and, getting pressurized in the pressure vessel.
- During the upward motion of the piston, fluid is sucked in and pressurized into the pressure vessel and, during downward movement, the sucked fluid crosses the plungers and enter the pump.

The pressure developed is about, 17-21 kg/cm2 or 60 – 80 psi and has a provision for attaching two discharge lines.

(vi) Pressure retaining knapsack sprayers

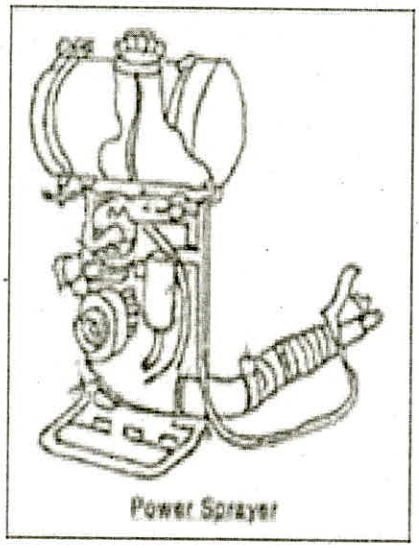
- Also known as the Battery Sprayer, this model permits the use of more than one tank depending upon the number of operators employed.
- A separate charge pump, with an inlet and an outlet device is used to fill the tank with air and liquid. The tank is first pumped with air up to a pressure of 40-50 psi and then charged with liquid, boosting the pressure to 100-110 psi.
- As soon as, the liquid is completely discharged from the tank, a check valve designed like a float seals the outlet vent, preventing the air from escaping.

(vii) Compression sprayers

- The tank is a pressure vessel in which the liquid is filled to two – third capacity.
- It is then pressurized to 60 psi by means of the air charge pump.
- A pressure gauge or safety valve may optionally be fitted to the tank.
- A pressure regulator, may also be used when the discharge pressure needs to be strictly controlled.

(B) Power Operated Sprayers

(i) Power sprayer



- The most commonly used type of power sprayer in India is a gaseous energy type knapsack sprayer.
- In construction, it has a back pack stand on which a blower with a S.I.
- Engine of 1.2 to 3 hp capacity, the spray fluid tank and the petrol tank are fixed rigidly.
- A pleated hose, is attached to the blower elbow to carry the high velocity air and, at the end of that a shear nozzle is fixed, to allow the spray fluid to trickle in from the spray fluid storage tank, with a valve control.

- From the top of the blower casing, an air hose is taken into the spray fluid tank, which carries little quantum of air to press the spray fluid during operation.
- In operation, the engine is started by keeping the unit on the ground and then carried by the operator.
- The blower sucks the air behind the backrest and forces it into the pleated hose.
- The valve of the shear nozzle is opened or the shear nozzle with selective opening and discharged through the nozzle.
- The high velocity air shears off the droplets and atomizes by the impact of diffuse and delivers it on the plant surface.
- An air current of 2.7 to 9.1 m2 / minute is delivered at a velocity of 175 to 320 kmph.
- The spray fluid tank capacity varies from 7 to 12 litres.
- The fuel tank capacity varies from 0.75 to 2.25 litres.
- The spray fluid discharge can be varied from 0.5 to 5 lit / minute.

(ii) Hydraulic pump sprayers

- Hydraulic sprayers may be engine or electric motor driven, and are available with single, double, and the triple piston pumps.
- The single piston pump develops a maximum pressure of 150 psi, whereas the double and triple piston type develops 300-400 psi. Only two discharge lines can be used with the single piston pump, whereas the double and triple piston pumps can accommodate 4-6 discharge lines.

"TEFLUTHRIN IS THE SYNTHETIC PYRETHROID DESIGNED SPECIFICALLY AS SOIL INSECTICIDE"

- Operation is by means of 1-2 HP electric motor, or 2-3 HP petrol, petrol-kerosene or diesel engine.
- These sprayers can also be driven by a power tiller or tractor.

(iii) Motorised Knapsack (Mist blower cum duster& sprayer)/Blower sprayer

- This sprayer cum duster is fitted with a two-stroke air cooled engine of 35 or 70 cc capacity, connected to a centrifugal fan by a direct drive.
- The spray liquid is first pressurized by air generated by the blower. This air current achieves a velocity of over 275 kmph at the nozzle, and sprays the chemical in fine particles than can be measured in microns.
- When dusting, the air blast enters the tank from an air inlet, which is connected, to a tube with several holes on its surface.

(iv) Tractor mount sprayers & Duster (Power take off-P.T.O. duster)

- As the name indicates, this sprayer is attached to a tractor for use.
- The pump is driven by the PTO shaft of the tractor, and the sprayer unit sucks the chemical and discharges it, through the spray boom, or through the discharge line consisting of a delivery hose and spray guns.
- The boom has a swivel arm to direct the spray correctly. The main frame allows the spray boom, to be adjusted according to the height of the crops being sprayed.

(v) Spinning disc sprayers

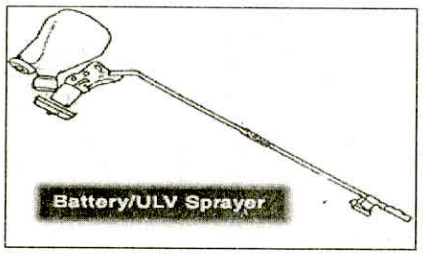
- Liquid is fed from the tank on to the spinning disc by the force of gravity. The spinning disc, which has 180 channels on the wall and 180 teeth on its periphery, operates at 4000-5000 rpm to stir the liquid and create very fine, even particles for low volume spraying.
- A smooth flow of liquid with highly controlled droplet (100-165 microns) application is thus achieved. The stainless steel disc is interchangeable.

(vi) Electrostatic spraying

- This sprayer consists of a battery operated motor with a spinning disc, a liquid tank, a handle and a set of batteries.
- The most commonly used version of this new system is the hand-held Electrodyn Sprayer, which atomises and propels charged droplets, by means of electrical forces set up between a high voltage, positively charged nozzle, the droplets and the earthed crop.

"ANDROCONIUM ARE THE SPECIALIZED MICROSCOPIC SCALES (SCENT SCALES) ON THE WINGS OF MALE BUTTERFLIES, FOR ATTRACTING THE FEMALES."

Battery or ULV sprayer



- ULV sprayer was invented as a result of the desire, to reduce the quantum of chemical carried by the man, for application and to eliminate the water, as a medium to carry the chemicals.

The basic requirements of ULV spraying are

- The narrow and controllable droplet spectrum (100-250 μm for fine sprayers, 50-100 μm for mist sprayers and 0.1 to 50 μm for aerosols)
- The accurately controllable emission rate.

The non-volatile pesticide formulation of suitable viscosity and density.

- The reduction in volume of the spray fluid decreases the time spent in travelling to recharge sprayer, in fetching water, in mixing the pesticide and filling the tank. In a day of 8 hour about 8 ha can be covered in ULV spraying against 3 ha with power sprayer.
- A battery operated ULV sprayer has a long handle and the horse power D.C. motor is fitted with a spinning disc and a cover.
- A HDPE bottle is fixed close to the motor, in such a way that spray fluid is allowed to trickle at the centre of the spinning disc in operation.
- Centrifugal energy imparted fluid comes out of the nozzle and atomizes.
- The hand held ULV applicators are so designed, to release the spray droplets at, 1 m away from the body of the operator.
- Further, it is recommended that it should be operated only when the spray cloud would be blown away from him by the breeze so as to minimize the risk of contamination.
- After spraying, the atomizer must be flushed with paraffin to remove the residual pesticide.

Power sprayer operated suction trap

- This consists of a metal elbow matching the suction opening and, the blower and the outer diameter of the pleated hose.
- This unit is closely fitted with, the blower suction opening with the help of an extension frame work, identical to the back pack stand.
- To the pleated hose attachment opening of the elbow a pleated hose is attached rigidly.
- In between the two pleated hoses a screen, an insect collector and valve to control the size of the opening are provided in a Tee section.

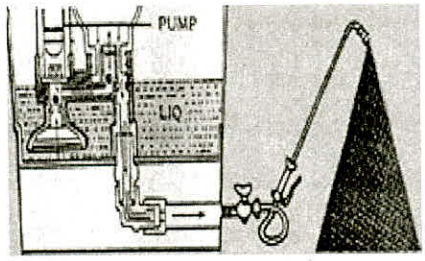
"THE PUPAL STAGE IN MOST BUTTERFLIES THAT DO NOT CONSTRUCT COCOONS IS CALLED AS CHRYSALIS."

- In operation, the low pressure created at the blower inside is transmitted through the below and, pleated hose which helps in sucking the lighter objects like insects and dust from a distance of 0.5 to 1.0 m away from it.

Working principle of spray equipment:

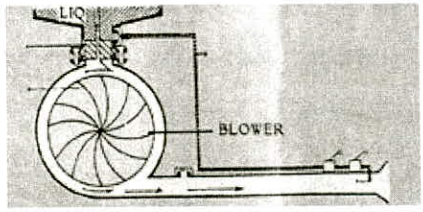
- Conversion of spray liquid into droplets is achieved using some form of energies.
- Various forms of kinetic energies such as hydraulic, gaseous and centrifugal are utilized in this process.
- The type of sprayer and nozzles or atomizers can be classified according to the energy used.

(i) Hydraulic Energy



- A reciprocating pump, operated mechanically by a lever. Pressurized by compression.
- This pressure forces the liquid out of nozzle in the form of spray particles.

(ii) Gaseous energy

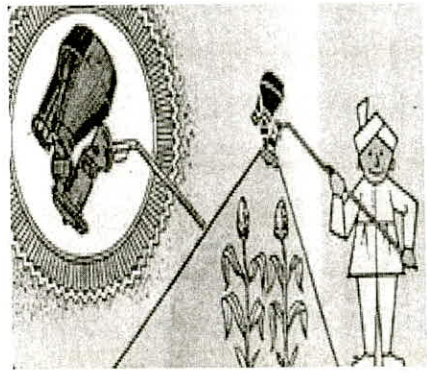


- A blower generates high wind velocity air. A liquid or dust is fed into air stream to be carried to the target.

(iii) Centrifugal energy

- A high speed spinning disc (flat, concave or cage or perforated cylinder) atomizes the spray liquid to fine droplets.

(iv) Spray Volume:



- Theoretically speaking, if ideal droplet diameter and the desirable droplet density are known, the minimum volume of pesticide spray per unit area can be calculated. Such a calculation of optimum droplet density is difficult because the effectiveness of the droplet is dependent on many other factors.

"DIFLUBENZURON IS THE FIRST CHITIN SYNTHESIS INHIBITOR DEVELOPED AS INSECTICIDE"

Nozzle

The nozzle performs four basic functions

- Atomizes liquid into droplets.
- Disperses the droplets in a specific pattern.
- Meters liquid at a certain flow rate.
- Provides hydraulic momentum.

Types of nozzles:

(i) Adjustable nozzle

- Most suitable for spraying targets which are not within the reach of a man.
- Gives a wide angle hollow cone to a straight solid stream that is, it gives a jet to a cone type of spray pattern.
- Difficult to calibrate as the flow and droplet sizes vary widely with the nozzle angle.

(ii) Double swirl spray nozzle

- Used for spraying in two different directions simultaneously.
- Nozzles can be fitted with different types of tips like hollow cone, solid cone or flat fan.
- Suitable for high volume applications.
- The shape and size of Nozzle Tip orifice controls the spray angle, discharge rate and spray pattern. Spray angle influences the swath of a spray.
- And also:-Droplet size increases as orifice size increases (for any given pressure). Droplet size decreases with an increase in fan angle (for any given nozzle size and pressure). When, it is desired to spray with more than one nozzle with the help of a spray rig or a spray boom, care should be taken in mounting, to avoid overlapping or gapping. Overlap, causes double dose and higher dose is harmful while, gap leaves untreated area with poor biological efficacy.

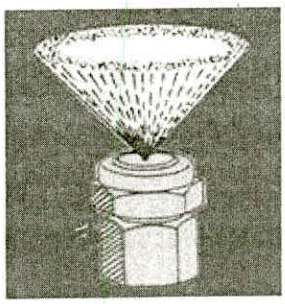
(iii) Selecting a spray nozzle

- The proper selection and, use of spray nozzle is the most important part of pesticide application. The nozzle, determines the amount of spray, that is generated over a given area, the uniformity of the spray produced, the coverage obtained and the amount of drift that occurs.
- The nozzle selected must optimize coverage application rate and pressure, and minimize loss through drift. For each kind of application, depending upon the physical conditions prevailing, a different nozzle design is available.

"IMMATURE STAGES POSSESSING SAME NUMBER OF BODY SEGMENTED AS ADULTS IS CALLED AS EPIMORPHIC DEVELOPMENT"

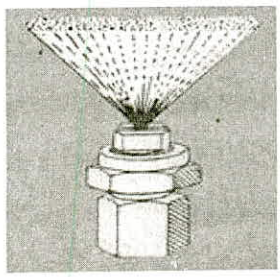
- Nozzle tips are usually available in brass, stainless steel, and engineering plastic. Steel tips are most resistant to corrosion and abrasion.
- Brass tips are very commonly used, but wear out more easily and can be corroded by some chemicals. Engineering plastic is likely to become the most serviceable material for spray nozzles, being highly resistant to wear-and-tear and corrosion.

(iv) Hollow cone nozzles-Disc and core type



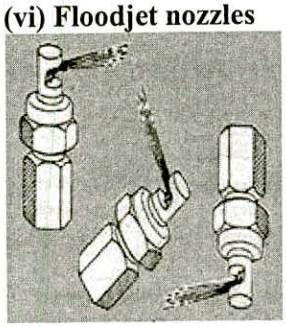
- These are used primarily, where plant foliage penetration is essential for effective insect and disease control, and where drift is not a major consideration.
- At pressures of 40 – 80 psi hollow cone nozzles give excellent spray coverage to the undersides of reduces penetration correspondingly.

(v) Flat fan nozzles



- These are used largely for broadcast spraying, where foliar penetration and coverage are not essential.
- The best operating pressure for flat fan nozzles is 15-30 psi, which produce coarser droplets that are not susceptible to drift.

(vi) Floodjet nozzles



- These are ideal for high application rates and speeds, because they produce a wide-angle, flat fan pattern.
- Operating flood-jet nozzles at 5-25 psi minimizes drift, but pressure changes critically affect the width of the spray pattern.
- Generally, the spray generated by the flood jet is not as uniform as the flat-fan type.

(vii) Adjustable nozzles

- This model is capable of producing a cone spray in various angles, and also a solid or broken jet spray.

"EPHEMEROPTERA A PTERYGOTE ORDER OF CLASS INSECTA IN WHICH ADULT UNDERGOES METAMORPHOSIS"

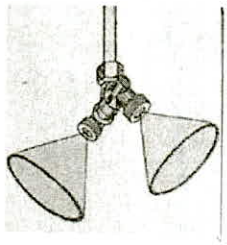
(viii)Single swivel nozzles

- Here the joint of the nozzle and extens on rod is capable of swiveling without leakage; it can be locked for use at any angle between 0-180 degrees.

(ix) Double swivel nozzles

- This has two swivel nozzles instead of one, capable of independent movement.

(x) Double fixed nozzles

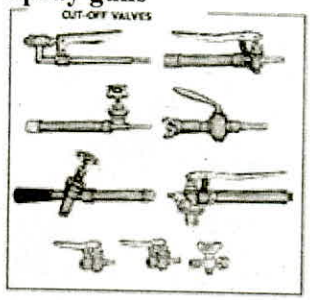


- Double fixed nozzles are fixed on the 'U' bend, which is, in turn, coupled with the end of a straight extension rod.
- NOTE: Single swivel, double swivel and double fixed nozzles come in both cones-spray and flat fan varieties.

Spray boom

- This design consists of several nozzles mounted on a rod, ideally suited to row crops, and can be operated with foot / rocker / knapsack / power operated sprayers.

Spray guns



- Spray guns consist of cut-of-value extension rod and nozzle and can be trigger or hand-operated.
- The spray pattern is adjustable from solid jet to hollow cone, and are most widely used for tall trees.

Spraying efficiency can be represented as follows:

$$\text{Spraying efficiency (\%)} = \frac{\text{Minimum spray volume required}}{\text{Actual spray volume applied}} \times 100\%$$

Spray Application Area

- The target infested by an insect, pest, disease or weed needs to be sprayed.
- Generally, the spray application area differs from the land area, except in the case where pre-sowing treatment is required on soil where, land area equals the area to be sprayed.
- The area required to be sprayed varies with the distance between the rows of plants, distance between the plants in the same row and growth of the crop.

Spray droplets.

- Droplet size and density (number of droplets per unit area of target) are two important factors for effective spraying.
- Knowledge of droplet diameter and density is important for efficient use of pesticides.
- The droplets diameter of a given spray can be measured as the median of either the volume or number of droplets.

The Volume Median Diameter (VMD)

- The Volume Median Diameter (VMD) is defined as that droplet diameter which, divides the volume of spray into two equal parts i.e. the volume of spray with droplets of a diameter less than VMD, equals the volume of droplets with a diameter greater than the VMD.

The Number Median Diameter (NMD)

- The Number Median Diameter (NMD), is the droplet diameter where, the number of droplets above the NMD is equal to the number of droplets below the NMD.
- The NMD is usually smaller than the VMD, because most pesticide sprays usually contain a large number of very small droplets.
- The VMD is affected by relatively few large droplets, whereas the NMD is more influenced by small droplets.
- The more uniform the size of droplets, the closer the ratio of VMD and NMD approaches.
- In a normal course, the spray droplets are in a spherical shape.
- To understand the mathematical logic and, for simplicity in calculations, the droplets may be considered in the shape of a cube and not a sphere.
- Imagine that the ideal spraying has been carried out which has produced all droplets of same size in cube shape having all sides of equal dimensions say 2 mm.
- The volume of a droplet is the sum arrived at after multiplication of length, breadth and height i.e. a cubic relation.
- If the droplet size is reduced from 2 mm to 1 mm, number of droplets produced will increase by 8 times from the same volume.
- The area occupied by the droplets is the sum arrived at after multiplying length and breadth i.e. a square relation.

"LINKAGES HAVE ALSO BEEN IDENTIFIED BETWEEN HOME AND GARDEN PESTICIDE USE AND LEUKEMIA AND BRAIN CANCER IN CHILDREN. A NATIONAL CANCER INSTITUTE STUDY IN THE U.S. INDICATES THAT CHILDREN ARE AS MUCH AS SIX TIMES MORE LIKELY TO GET CHILDHOOD LEUKEMIA WHEN PESTICIDES ARE USED IN THE HOME AND GARDEN."

Optimum Droplet Size

- Optimum droplet size for application of pesticide are generally specified within a range of droplet diameter.
- More precise definition of optimum droplet size, in application of pesticide on Agricultural Pests may not be possible, due to biological complexity of target.
- Besides this, the fate of droplets from the time of their formation by a nozzle, until their deposition onto a target is influenced by several factors such as:
- Velocity of droplet ejection
- Gravitational force
- Wind velocity
- Air Turbulence caused by thermal movement
- Volatility of the spray liquid and
- Characteristics of target surface
- Droplet size is most important for efficient application with minimum contamination of environment. A 500 micron droplet will contain 1000 times the lethal dose than that of a 50 micron droplet. To reduce wastage, narrow range of droplet spectrum is essential.
- Coarse droplets are largely influenced by gravitational force and, relatively unaffected by turbulence. Fine droplets will be influenced by wind and turbulence and have a tendency to drift.

Target	Droplet sizes (Microns)
Flying Insects	10-50
Insects on foliage	30-50
Foliage	40-100
Soil application (avoidance to drift)	250-500

- Different spraying techniques like High Volume (HV), Low Volume (LV) and Ultra Low Volume (ULV) are most commonly used.
- Droplet sizes more than 300 microns are lost by drip whereas the droplet sizes less than 100 microns are lost by drift.
- Loss of spray by drip and drift are more prominent in HV and ULV spraying technique, respectively.

"PYRETHROIDS, SUCH AS PERMETHRIN, WERE FIRST MADE BASED ON CHEMICALS NATURALLY OCCURRING IN THE SEEDS OF CERTAIN CHRYSANTHEMUMS. THESE ACT SIMILARLY TO THEIR NATURAL RELATIVES, DISRUPTING THE TRANSMISSION OF NERVE IMPULSES, BUT LAST LONGER."

Practical No.-6

Title : Minor Repairing and maintenance of insecticide Applicators

Objective : To understand about the common problems of insecticide application equipments and their remedies.

In agricultural operations use of equipments are done for dusting, spraying and fumigation, repeatedly use of these equipments, may cause certain problems. It is essential to understand and solve these problems. The most common equipments, used for agricultural operations their problems and remedies are as follows:-

Hand- compression sprayer.

No.	Trouble	Cause	Remedy
1.	No discharge or partial discharge	Nozzle blocked	Remove nozzle block by cleaning.
		Trigger cut off loose	Set trigger cut off to correct position
		Worn-out gasket or washer	Replace gasket or washer
		Blocked delivery tube	Remove the delivery tube and clean it; replace it back.
2.	Leak from pump	Worn-out air-check valve	Replace air-check valv
3.	Poor state of spray	Reduced pressure in the container	Recharge the sprayer gap to be given with compressed air.
		Worn out seals or washers of filler cap, air pump or delivery tube	Replace the seals or washers and tighten the cap properly

"THE SIZE OF SMOKE PARTICLE IS 0.001-0.1 MICRONS, THE SMOKE GENERATORS USED IN CONFINED AREAS LIKE GREEN HOUSE, WARE HOUSE AND GODOWNS"

Pneumatic knapsack sprayer.

No.	Trouble	Cause	Remedy
1.	No discharge or partial discharge	Blocked nozzle	Clear nozzle block
		Blocked cut-off Value	Clean and replace Cut-off valve
		Blocked delivery line or leakage.	Clean and tighten the connection of delivery line.
		Worn-out gasket or damaged plunger	Replace gasket or damaged plunger
2.	Leak from pump	Worn-out valve	Replace valve
		Worn-out pump Washer or seal	Replace washer or seal
3.	Poor state of spray	Reduced air pressure in the container	Recharge the sprayer
4.	Pressure drops quickly	Air leak through tank of sprayer filler cap or delivery hose connected to tank.	Check the tank for leakage and gas-weld it. Replace, rubber seal of filler cap or tighten the connection.

"THE ONLY PEST THAT HAS DEVELOPED RESISTANCE TO *BACILLUS THURINGIENSIS* IN THE FIELD CONDITIONS IS *PLUTELLA XYLOSTELLA*"

Hydraulic knapsack sprayer.

No.	Trouble	Cause	Remedy
1.	No discharge or partial discharge	Worn-out piston ring or damaged piston	Replace, piston ring or piston
		Damaged suction or delivery-diaphragm valve	Replace valve
		Blocked suction rate	Clean suction line
		Slower pumping rate	Maintain uniform Pumping rate
2.	Piston hard to operate.	Blocked delivery line	Clean the delivery line
	Operates hardly	Over-sized piston ring	Replace piston with a correct size
		Insufficient lubrication or handle bearing	Lubricate cylinder piston or bearing
3.	Poor state of mist	Slower pumping rate	Maintain uniform pumping rate
		Loose connection at pressure chamber and valve joint	Tighten pressure chamber and valve joint properly
		Partially blocked nozzle valve or orifice	Clean the valve or orifice in clean water
4.	Liquid leakage	Damaged gasket or gland packing	Replace the gasket or gland packing.

"THE TSETSE FLY IS FOUND ONLY IN AFRICA ALTHOUGH THERE ARE TWENTY-TWO DIFFERENT SPECIES OF THE TSETSE FLY"

Major troubles in operating a rocking sprayer and remedies.

No.	Trouble	Cause	Remedy
1.	Piston hard to operate.	Lock nut to tight	Lock nut should be loosened
	Piston loose to operate	Lock nut to loose	Lock nut should be tightened
2.	Pressure not retained at required operating pressure.	Gasket of pressure chamber worn out	Replace the worn-out gasket.
3.	Piston worn out or contracted	No discharge or partial discharge, or liquid leakage	Tighten lock nut or replace piston ring or washers.
4.	Liquid leakage at joints	Loose connection	Tighten the joints
		Damaged gaskets	Replace the gaskets

Major points of troubles in foot sprayer and their remedies.

No.	Trouble	Cause	Remedy
1.	Pedal does not function properly or does not give spray	Check the return spring tension with correct tension	Replace return spring of high or low tension
2.	Plunger hard to operate	Blocked delivery line	Clean the delivery line.
		Bent plunger rod	Straighten or replace plunger rod.
3.	Leaking of spray fluid along the side of plunger rod	Worn-out gasket or packing	Replace worn-out gasket and packing.
4.	Spray fluid pressure drops suddenly	Leakage in pressure chamber	Repair pressure chamber or replace it.
5.	Poor spray or mist	Slow pumping rate	Maintain correct Pumping rate
		Partially blocked Nozzle	Clean the nozzle to remove block
		Reverse position of nozzle disc	Place the nozzle disc correctly

"*PLUTELLA XYLOSTELLA* IS THE INSECT WHICH HAS DEVELOPED RESISTANCE TO MAXIMUM NUMBER OF INSECTICIDES IN FIELD CONDITIONS"

Troubles and remedies in portable power sprayer.

No.	Trouble	Cause	Remedy
1.	Failure to develop pressure Failure to maintain pressure	Clogged strainer	Clean strainer
		Leakage of suction Line	Check suction line and make it leak-proof.
		Stuck, worn-out or damaged valves	Examine the valves, and replace valves
		Worn-out valve seat	Replace valve seat
		Worn-out piston	Replace piston
		Slow pumping speed	Check belt tension and adjust to correct tension
		Weak spring of bypass value	Replace it
		Leakage of bypass valve	Inspect and correct it.
2.	Leakage from spray gun	Dried or worn-out packing or seal	Replace the packing or seal
3.	Heavy discharge rate	Worn-out disc aperture	Replace the disc

"CRICKETS ARE GOOD TEMPERATURE READER AS ITS CHIRPS DIFFER ACCORDING TO THE WEATHER"

Troubles and their remedies in knapsack mist blower-cum-duster.

No.	Trouble	Cause	Remedy
1.	No discharge or partial discharge of spray fluid	Blocked delivery line	Clean the delivery line.
		Close cut-off cock	Open the cut-off cock.
2.	Poor state of mist	Damaged deflector disc	Replace the deflector disc
		Leaky air-line from blower housing	Replace with new gasket or tighten it
		blower housing bolts	
		Air leak through the hose	The pleated hose may be replaced or sealed with proper adhesive
		Low engine speed	Check belt tension and adjust to correct tension
		Blower shaft is loose	Tighten the bearing bolts of blower shaft
3.	No discharge or partial discharge of dust	Wrong placement of dust-agitator pipe	Remove and replace it correctly
		leaky air-line in blower housing	Replace the blower-housing gasket or tighten bolts
		Low blower speed	Check the working of engine.

"FLEAS CAN LEAP EIGHT HUNDRED TIMES FARTHER THAN THEIR BODY LENGTH"

Troubles in plunger duster and remedial measures.

No.	Trouble	Cause	Remedy
1.	No discharge of dust	Worn out or under sized plunger	Replace the component of plunger bucket assembly
		Clogging of holes in wire-mesh	Clean the wire-mesh holes
2.	Hard-to-operate plunger	Bent plunger rod or lack of lubrication	Straighten the plunger rod or replace it; apply grease lightly on the plunger rod

Troubles and remedies in hand rotary duster.

No.	Trouble	Cause	Remedy
1.	No discharge of dust	Blockage of dust inlet	Clean the suction pipe
		Stoppage of feeding mechanism	Tighten the feeding mechanism on the shaft.
		Improper mating of gears or gear teeth worn-out.	Proper lubrication: replace with new gears for proper mating.
2.	Blower touches the case	Worn-out bearing	Replace bearing
		Bent shaft	Straighten shaft

"MORE THAN 500 INSECT PESTS, 270 WEED SPECIES AND 150 PLANT DISEASES ARE NOW RESISTANT TO ONE OR MORE PESTICIDES"

Troubles and remedies in spinning disc sprayer.

No.	Trouble	Cause	Remedy
1.	No supply of particle spray. Producing large droplets.	Clogged gravity feed tube or nozzle.	Clean the tube of nozzle, replace if there is leakage.
		Damaged or blocked	Clean or replace productive cover
		Low disc speed	Check for loose connection and battery charge.
		Spray fluid leakage	Fit the chemical bottle correctly
2.	Disc is not spinning	Disc is stuck	Remove the disc and fit properly or replace it.
		Loose connection	Check and make proper connection
		Low or no voltage	Charge or replace battery
3.	Motor is not running	Motor damaged	Repair or replace motor
		Loose switch connection	Repair or replace on/ off switch.
		Check polarity of terminal	Switch, connect battery terminals correctly

"MAXIMUM RESIDUE LIMIT (MRL), IS THE HIGHEST CONCENTRATION OF A RESIDUE OF A PARTICULAR CHEMICAL THAT IS LEGALLY PERMITTED OR ACCEPTED IN A FOOD OR ANIMAL FEED"

Practical No. 7

Title : Tools for Monitoring/Management of Insect pest.

Objective : To make acquainted about the structure, working and utilization of different tools used for monitoring and management of insect pest.

Light traps:

Light acts as a source of attraction for some insects, has been deployed to catch insects in suitable traps. Most of the insect species are nocturnal and are positively phototrophic, this phenomenon has been utilized by the entomologists, to capture adult insects in a device called light trap.In agriculture, light trap is an important tool in insect ecological research and pest management.

They are used for the following purposes. _

- Determining the presence or absence of insect species in an area.
- Obtaining quantitative estimates of population density, species composition, age and sex.
- Providing early warnings of crop infestation and oviposition.
- Determining economic threshold levels to assist insecticide application.
- Suppressing population to help managing the pest.
- Detecting migration.
- An ideal light trap should be cheap, durable and robust. It should be serviced easily by, personnel of little training, should be highly efficient and attract a large number of insects of different species.

Trap design:- Light traps vary in design but generally consist of three components *viz.,* 1) a light source 2) arrangement of baffles around the source 3) a catch container with a killing agent.

Light Source:- Various types of light sources have been tested and used. Numerous studies have shown that the shorter visible and near ultraviolet wavelengths between 320-600 nm are most attractive to a wide variety of insects. The most efficient sources are the mercury vapour lamp and fluorescent tubes.

Baffles :- Most light traps are fitted with baffles, which surround the bulb. They are often three or four, arranged perpendicular to each other to help retain these insects and thus greatly increase the catch of a trap. They may be made from an opaque material such as galvanized iron, or from a transparent material such as acrylic.

Container:- In most traps, insect attracted to light fall into a funnel, fixed below which opens into a killing and holding container. Dichlorovos is commonly used as a killing agent. Kerosene and water mixed with some detergent also serve as killing agent, in many local light traps.

"WEBSPINNERS (EMBIOPTERA) THE SILK IS PRODUCED FROM GLANDS IN THE TARSI OF THE FRONT LEGS OF BOTH SEXES, NYMPHS AS WELL AS ADULTS."

Pesticide products are made of an active ingredient and several inert, or other, ingredients. Inert ingredients are neither chemically, biologically nor toxicologically inert. Inserts are not disclosed to the public due to their status as "trade secrets".

Some of the commonly used light traps are

- The Chinsura light trap
- Mercury vapour lamp
- Modified Robinson light trap
- Rothamsted trap
- The Pennsylvania and Texas trap
- The new Jersy trap

Advantages:

1. Both male and females are attracted and there is possibility of using them as a control measure.
2. It is an eco-friendly measure of control since, it is non-insecticidal.
3. It is compatible with, any other methods of control in IPM.
4. It is simple, cheap and can be handled even by a less trained person.

Disadvantages:

1. Beneficial non target insect species may also be trapped.
2. Light trap data vary with the weather conditions, as well as moon light phases.
3. Availability of power source restricts trap installation.
4. It is not specific to a particular species of insect, and therefore cumbersome to work with mixtures.
5. It should be operated in a large area and useful for strong flying insects.

Pheromone traps:

Pheromones are semiochemicals that are secreted into the external environment by insect which elicit a specific response in receiving individuals of the same species.

These chemicals are also called as ectohormones. Pheromones are identified by extracting them from the insects, and later synthesized artificially. The synthesized product is then, impregnated in rubberized septa and used in integrated pest management.

Pheromones are used in integrated pest management (IPM) programmers for,

a) Population density surveys

b) Forewarn regarding outbreaks of important insect pests

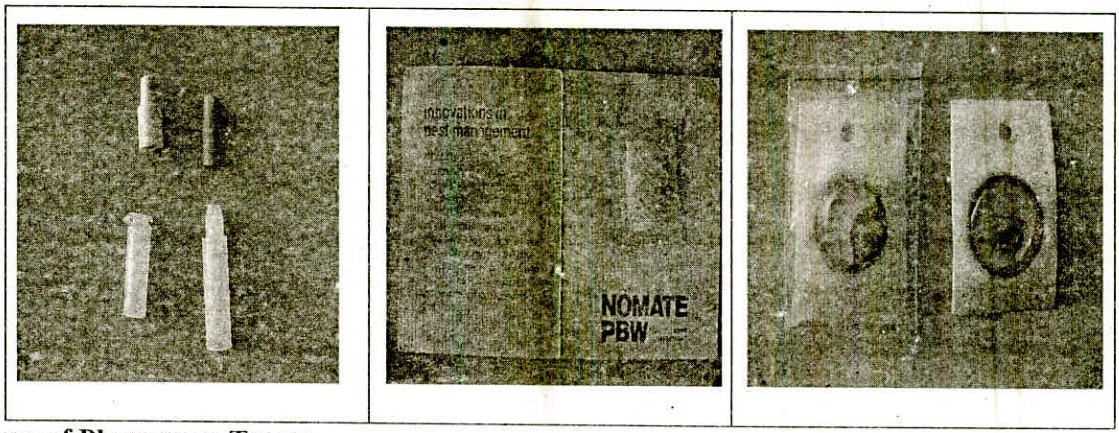
c) Male confusion – Mating disruption

"FIRST GENERATION RODENTICIDES ARE WARFARIN, COUMATETRALYL"

Pheromones have greater direct behavioural control usefulness in surveys, to determine the presence/abundance of insect species, so that other control measures can be exercised. Several models of pheromone applications and traps are available.

Modes of Pheromone Application:

1. **Rubber septa** – sulphur free
2. **Hollow fibres:** Small thermo-plastic tubing sealed at one end & filled with pheromone. Pheromone release depends on evaporation through open end. Effectiveness is controlled by adjusting the length.
3. **Twist tie ropes:** 15 cm long plastic tube containing pheromone sealed at both ends is attached to crop manually. High concentration of pheromone provides relatively long persistence of release.
4. **Laminated flakes:** Two layers of vinyl sandwiching central porous layer with pheromone. Flakes are applied with sticker and thickening agent -through special equipment or by hand. Emission rate from flakes -controlled by layer thickness & chemical concentration.
5. **Micro capsules**: Micro encapsulation of small droplets of pheromone-done by using polymer can be easily manufactured on large scale. Readily applied over a large area with conventional sprayers.



Types of Pheromone Traps:

1. Delta trap : It is a rigid and durable plastic trap using a replaceable sticky insert. The insert on its top consists of a non-drying adhesive. It can be removed by opening one end of the trap. Pheromone lures are placed in the centre of the sticky insert. Catch inspection is possible, without the need for dismantling the trap. The dispensers and sticky inserts should be replaced every six weeks. Traps should be inspected once in every two to three weeks.

2. Funnel trap : Robust trap made of moulded plastic with a large base and removable cap, for housing a pheromone dispenser. Kits may be supplied with an optional killing agent (insecticidal strip) or an insecticidal spray may be used inside the trap for control purpose.

"MANTOPHASMATODEA IS THE NEW INSECT ORDER WHICH INCLUDES GLADIATORS, HEELWALKERS AND MANOTOPHASMIDS".

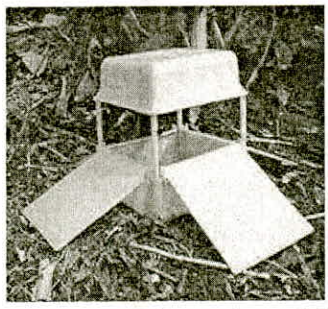
Flying insect pests are lured into the trap by the pheromone attractant. Insects once enter the trap, unable to escape and are exposed to the insecticidal strip.

3. Probe trap: This is used in grain storage silos. It is an acrylic cylindrical tube with small angled holes drilled on the upper 2/3rd of its length. Lower part of the tube contains a removable collection tube. At the top of the trap, there are two holes to pass a card to fix a marker . The trap is vertically buried in the grain 0.5 to 1 m below the grain surface. The trap should be kept at 10-35 m distance. The crawling insects enter the tap through holes and fall into the specimen tube through funnel.

4. Omni directional pheromone trap : It is exclusively used for monitoring *Earias*. It consists of an aluminium vessel of 30 cm diameter. Holes are provided on the sides of vessels. The trap contains a septum on the inner side and hung in the field.

5. Bait trap: The olfactory stimuli from the food source attract insects and are manipulated in the pest management.

6. Poison bait trap: This is used to trap and collect the larvae of *Spodoptera litura.* Poison bait consists of 500 g of molasses, 5 kg of rice bran and 500 g of carbaryl 50 wp/acre. The pelleted baits are kept along the irrigation channels during evening hours to attract the caterpillars. Upon ingestion of the bait containing carbaryl 50% wp, larvae will be killed.



Advantages of pheromones in pest control :

1. Pheromones are safe to environment.
2. They are species specific.
3. They are safe to natural enemies.
4. Pheromones need small doses.
5. Compatible with other pest management programmes.
6. They are economical than other control techniques.

Disadvantages:

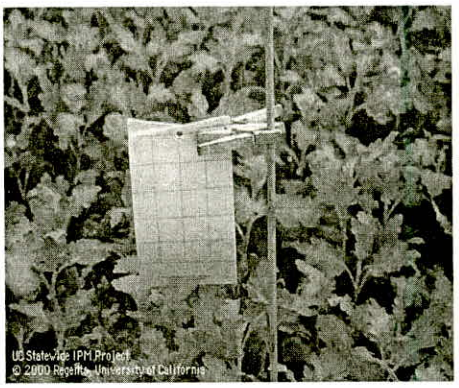
1. Basic behaviour of most of important insect pests like pheromone reception, migration *etc*. was not fully understood.

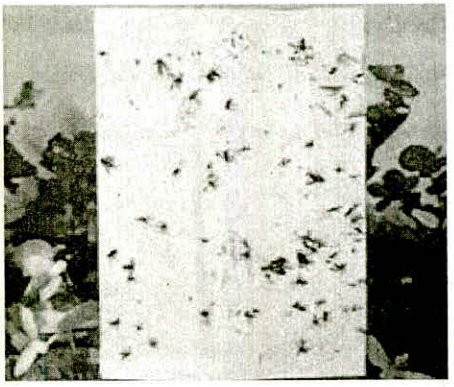
"ANDROCONIUM ARE THE SPECIALIZED MICROSCOPIC SCALES (SCENT SCALES) ON THE WINGS OF MALE BUTTERFLIES, FOR ATTRACTING THE FEMALES."

2. The pheromones of a few insects were only identified; a large number of them are still to be identified.
3. If the crop is affected by more than one pest, and when pheromone trap is placed for major pest, there are chances of secondary pest outbreak.

Sticky traps: Yellow sticky boards.

For use, place 1 to 4 yellow sticky cards per 300 square metres field area. Replace traps at least once a week. It is difficult to determine the population of newly trapped insects on a sticky card from those previously trapped. To make your own sticky trap, spread petroleum jelly or used motor oil on yellow painted plywood, 6 cm x 15 cm in size or 30 cm x 30 cm. Place traps near the plants, but far away enough to prevent the leaves from sticking to the board. Traps when hung should be positioned 60 to 70 cm zone above the plants. Yellow sticky traps are mainly used to monitor, whiteflies, winged aphids and leaf mining flies.





- **Yellow plastic trapping sheets**. A 2 m x 75 cm yellow plastic sheet coated with motor oil, both ends attached to bamboo or wooden poles and carried by two persons through the field to mass capture adult flies.
- **Yellow plastic drinking cups** coated with adhesives and stapled on stakes above plant canopies to trap flies.

Advantages

- Adults of whiteflies, thrips, fungus gnats, leaf miners, psyllids,winged aphids, and parasites can be monitored with yellow sticky traps.
- Traps warn of pest presence, hot spots, and migration.
- Traps provide a relative measure of insect density; comparisons of the number of adults caught among sample dates may indicate, whether pest density is changing or remaining relatively constant over the long term.

"SECOND GENERATION RODENTICIDES ARE DIFENACOUM, BRODIFACOUM, FLOCOUMAFEN AND BROMADIOLONE"

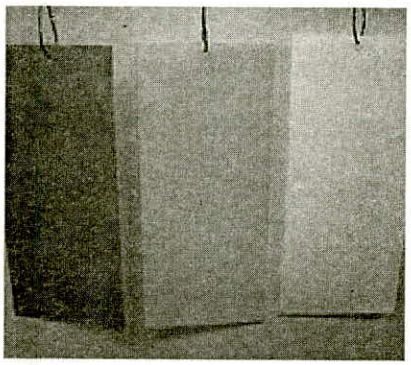
- Traps are often a very efficient and important monitoring tool, alerting growers to pests early, before damage is observed in crops.

Disadvantages:-

- Traps may not be a good tool for deciding treatment need or timing.
- Immature stages in crops commonly cause most damage, and traps typically capture only airborne adults.
- Adult trapping sometimes, is not a reliable indicator of pest presence or abundance on the crop, and traps must be used in combination with visual inspection of plants.
- Wind and ventilation fans can discourage flight, reducing trap catches.

"Residue" in agriculture is a term used to describe a small amount of chemical or its breakdown products that remain in or on a product.

Coloured traps:-

Some flying insects are attracted to specific colors. Colored traps can be coated with a sticky substance to capture these insects. Proper construction and placement of the traps are critical, since they must present, the proper appearance (visual image and/or color)to the targeted pest to be effective.

- Yellow objects attract many insects and are often used in traps designed to detect the flights of aphids and to control adult whiteflies in greenhouses.
- Red spheres, coated with an adhesive and baited with an attractant, can be used to capture apple maggot flies and limit damage to fruit.
- Blister beetles ,thrips and leaf miners are attracted to blue colours. This fact can be utilized to create traps for them.For beetles take any light blue container, fill with soapy water and place around susceptible crops like beans, cowpeas and pigeon peas. The beetles fall in and drown.

"MOST ENVIRONMENTAL RISKS AND ECOLOGICAL DAMAGE FROM PESTICIDE USE RESULT FROM TOXIC EFFECTS OF PESTICIDES ON VARIOUS LIVING ORGANISMS. STUDIES HAVE FOUND INSECTICIDES ARE THE MOST TOXIC CLASS OF PESTICIDES, FOLLOWED BY HERBICIDES, ACARICIDES AND FUNGICIDES."

Practical No. 8

Title : Precautions during application of various formulations of Insecticides

Objective : To learn about safe methods of using different insecticidal formulations .

Danger of exposure always exists whenever pesticides are handled. Before beginning pesticide handling activities, be sure and prepare to deal with emergencies such as spills, injuries and poisoning. Emergencies supplies should include at least;

- Clean water, detergent and paper towels keep in a protected container to allow for fast decontamination in an emergency.
- First aid equipments.

Purchase

- Buy the correct products
- Buy only recommended products in required pack for use. Check carefully the brand as well as chemical names.
- Do not buy damaged packs
  Check seals carefully for signs of tampering. Refuse to take any pack that is damaged, leaking or whose seals have been tampered with or which do not possess original labels.
- Purchase the pesticides from authorized dealer or distributor. This ensures to get a genuine product.
- Check the date of manufacturing and expiry on the pesticide pack. Do not purchase date-expired stock.
- Insist on getting a bill.
- Do not purchase any loose pesticides.

B) Transport

- Obey laws and regulations regarding transportation of pesticides.
- Keep pesticides away from passengers, live stock and food stuffs.
- Load and unload carefully
- Transport pesticides alone from retailer shop to the farm house.

C) Storage

- Do not store pesticides along with food or animal feeds
- Keep pesticides under lock and key away from children and animals.
- Keep in cool dry place. Check label for advice on storage. Keep away from fires and direct sunlight.

"CHLORINATED HYDROCARBOANS, CYCLODIENES AND PYRETHROIDS ARE AXONIC POISONS WHILE, NICOTINE, NICOTINE SULFATE NEONICOTINOIDS AND SPINOSYNS ARE SYNAPTIC POISONS, THESE SYNAPTIC POISONS MIMICS ACETYLCHOLINE AT THE SYNAPSE"

- Never store pesticides for farm use in living quarters.
- Inspect packages regularly for leaks and signs of damage.
- Do not store pesticides in a damp room.
- Do not store pesticides on the floor. Instead store them in a rack.
- Do not store pesticides in refilled packs. Store in original packs.
- Do not store empty containers on the floor but break them and keep in a drum till destruction.
- Do not store pesticides along with seeds.
- Do not eat, drink, smoke or chew tobacco in the pesticide store.
- Do not have temporary and old electric wiring connection in pesticide store

(D) Measuring and Mixing of pesticides

- Always adhere to the recommended doses and dilutions.
- Read the label and instructions leaflet carefully, to determine the proper dose rate, mixing instructions and equipments to be used.
- Ready for use solid/liquid products such as dusts, granules and ULV sprays can be tipped or scooped from their packs directly into application equipment..
- Do not use bare hands while handling pesticides.
- The tank should be filled with water to the correct level and mixed well with a stick.
- Do not fill sprayer up to the brim, they may spill during use.
- If a stock of spray liquid is being prepared, do not make up more than what can be used up during the same day. Avoid keeping spray liquid overnight.
- Wear protective clothing.
- Do not measure out or mix pesticides in or near houses or where livestock are kept.
- Take care not to contaminate water supplies or puddle from which animals may drink..
- Never suck liquid pesticide with mouth, even with a tube.
- Handle dusts and wettable powders carefully to avoid fluffing up.
- Wash all equipments after use.
- Mixing vessels and measures used for pesticides must not be used for any other purpose.
- Close-up packages after use to prevent leaks or contamination and store safely.
- Small quantities of left-over and unwanted concentrates should be tipped into a hole in the ground away from dwellings, wells, water ways and crops.

"COTTON CROP RECEIVES 43.5 PERCENT OF THE TOTAL PESTICIDES USED, FOLLOWED BY RICE 21.8 PERCENT AND PULSES 8.1 PER CENT"

(E) Application equipment - Use, maintenance and repair

- Clean and check equipment at the end of each day's operations. Pay particular attention to thorough cleaning of the equipment, especially if not to be used again for some time, because residual pesticides may cause corrosion and clogging.
- Some pesticides are easily washed off by rain, and need a rain free period after application to the product label will indicate where this is so.
- Keep people and animals out of freshly treated crops.

(F) Safe application techniques

- Do not work in strong winds.
- Work so that any wind blows the pesticide away from operators, not onto them.
- Do not blow out clogged nozzles with the mouth.
- Keep all people and animals away.
- Never leave pesticides and equipment unattended.
- Never leave pesticide containers open. Collect up all wastes such as empty packages for safe disposal.
- Wash hands and face before eating, drinking or smoking.
- Do not eat, drink or smoke during work
- Do not touch face or other base skin with soiled gloves or hands.
- Wash gloves before removal.
- Wash thoroughly after work and wash clothing undergarments each day.

"SPINOSYNS ARE ISOLATED FROM ACTINOMYCETES, *SACCHAROPOLYSPORA SPINOSA* UNDER NATURAL FERMENTATION. THE MIXTURE OF SPINOSYN A AND D IS CALLED SPINOSAD, IT IS A CONTACT AND STOMACH POISON, IT BLOCKS NICOTINIC ACETYLCHOLINE RECEPTOR, AND EFFECTS GABA (GAMA-AMINOBUTYRIC ACID) RECEPTOR, EFFECTIVE AGAINST BOLL-WORMS"

Practical No.9

Title : First aid measures.
Objective : To impart basic knowledge about preventive and the preliminary medical assistance to pesticide exposed person

While, handling the insecticides the operator and other persons may come into contact with it. the body parts like hands ,legs and parts of skin may come in contact, sometimes insecticide may get entered inside the body through orally or inhalation ; accordingly different preventive and curative measures required to be taken. Followings are the in general examples of contaminations and their curative measures.

Poison on the Skin

- The faster the poison is washed off the patient, the less injury that will result.
- Drench skin and clothing with water (shower, hose, faucet, and pond).
- Remove clothing.
- Cleanse skin and hair thoroughly with soap and water. Detergents and commercial cleansers are better than soap.
- Dry and wrap in a blanket.

Poison in the Eye

- It is most important to wash the eye out quickly but as gently as possible.
- Hold eyelids open and wash eye with a gentle stream of clean running water.
- Continue washing for fifteen minutes or more. It is important to use a large volume of water. If possible, at least five gallons should be used to flush the eye properly.
- Do not use chemicals or drugs in wash water. They may increase the extent of the injury.
- Cover the eye with a clean piece of cloth and seek medical attention immediately.

Inhaled Poisons (dusts, vapors, gases)

- If victim is in an enclosed space, do not go in after him unless you are wearing an air-supplied respirator.
- Carry patient (do not let him walk) to fresh air immediately.
- Open all doors and windows.
- Loosen all tight clothing.
- Apply artificial respiration, if breathing has stopped or is irregular.
- Keep victim as quiet as possible.
- If victim is convulsing, watch his breathing and protect him from falling and striking his head. Keep his chin up so his air passage will remain free for breathing.
- Prevent chilling (wrap patient in blankets but don't overheat).
- Do not give the victim alcohol in any form.

"WIND TUNNEL AND Y OLFACTO METER ARE USED TO MEASURE THE BEHAVIOUR OF INSECTS TOWARDS THE ODOUR SOURCE"

Swallowed Poisons -- The most important choice one have to make, when aiding a person who has swallowed a pesticide, is whether or not to make him vomit. The decision must be made quickly and accurately, by a health care professional because, the victim's life may depend on it. Usually, it is best to get rid of the swallowed poison fast.

- **Never** induce vomiting, if the victim is unconscious or is having convulsions.
- **Never** induce vomiting, if the victim has swallowed a corrosive poison. A corrosive poison is strong acid or alkali. The victim will complain of severe pain and will show signs of severe mouth and throat burns.
- **Never** induce vomiting, if the person has swallowed petroleum products such as kerosene, gasoline, oil, or lighter fluid.

How to Induce Vomiting

- First give the patient large doses of milk or water. One to two cups for victims up to five years old; up to a quart for victims five years and older.
- If victim is alert and respiration is not depressed, give syrup of ipecac followed by one to two glasses of water to induce vomiting. Adults (twelve years and over): 30 ml (two tablespoons); children under twelve years: 15 ml (one tablespoon). Activity hastens the effect of the syrup of ipecac.
- Collect some of the vomits, for the doctor he may need it for chemical tests.

First Aid Kit for Field

A well equipped first aid kit, which is always readily available can be important in a pesticide emergency. Make up your own pesticide first aid kit from a lunch pail, tool box, or a sturdy wooden box. It should have a tight fitting cover with a latch, so that it won't come open or allow pesticides to leak inside. Label it clearly with paint. Kit should contain:-

1. A small plastic bottle of a common Detergent. It is used to wash pesticides quickly off the skin.
2. A small package or bag of Activated Charcoal. Mixed with water and swallowed, activated charcoal acts as an absorber of all pesticides.
3. A thermos or large plastic bottle (at least one quart) of Clean Water. If there is no clean water in an emergency, use any pond or stream water that is available.
4. Simple Band Aids, Bandages and Tape. All cuts and scrapes should be covered to prevent pesticides from easily entering the body.
5. A Blanket is very useful. It should be kept in a place, where it will not be contaminated by pesticides.

"DPPQ AND S (DIRECOTRATE OF PLANT PROTECTION, QUARANTINE AND STORAGE) IS A NODAL AGENCY, FOR ISSUEING IMPORT PERMIT; WITHIN THE DIRECTORATE CIB (CENTRAL INSECTICIDE BOARD), RC (REGISTRATION COMMITTEE), CIL (CENTRAL INSECTICIDE LAB) AND PLANT QUARANTINE WORK ARE INCLUDED"

Antidotes for Pesticide Poisoning

Antidotes, such as those described below should be prescribed or given only by a qualified physician. They can be very dangerous, if misused.

Group I Organophosphate

DDVP, Demeton , Diazinon, dimethoate (Cygon), chlorpyriphos, fenthion, Guthion, Metasystox, Methyl parathion, parathion, phorate, Phosdrin, phosphamidon, Schradan,TEPP.

Antidotes:

1. Atropine Sulfate is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur.
2. Protopam Chloride (2-PAM) should also be injected to counteract organophosphate poisonings. It is given intravenously.
3. Sodium bicarbonate for organophosphate compounds.

Group II Carbamates

Aldicarb , carbofuran , methomyl, carbaryl.

Antidotes:

1. Atropine Sulfate (2-4 mg intramuscular/intravenous administration) is used to counteract the effects of cholinesterase inhibitors. Injections should be repeated as symptoms recur.
2. Do Not Use Protopam Chloride (2-PAM).

Group III Chlorinated Hydrocarbons

Endrin, dieldrin, aldrin, lindane, endosulfan .

Antidotes:

1. Barbiturates for convulsions or restlessness.
2. Calcium Gluconate given intravenously for carbon tetrachloride, ethylene dichloride, chlorinated insecticide, mercurial compounds.
3. Sodium bicarbonate for stomach poisons of dinitrophenols.
4. Do Not Use epinephrine (adrenalin).

Group IV Synthetic pyrethroids

1. Phenobarbital.
2. Diphenyl hydration.

Group V Cyanides

For Poisons Such As: hydrogen cyanide, Cyanogas.

"MENOTAXIS IS MORE COMPLEX FORM OF PHOTOTAXIS IN WHICH AN INSECT ORIENTS ITSELF AND MOVES WITH ITS BODY AT A CONSTANT ANGLE TO THE LIGHT SOURCE"

Antidotes:

1. **Amyl Nitrite** through inhalation.
2. **Sodium Nitrite** given intravenously.
3. **Sodium Thiosulfate** given intravenously.

Group VI Anticoagulants

For Poisons Such As: warfarin, Fumarin, Pival, PMP (Valone), diphacinone (Diphacin).

Antidotes:

1. **Vitamin K** (K_1 and K_2) orally, intramuscularly, or intravenously.
2. **Vitamin C** useful adjunct.

Group VII Fluoroacetates

For Poisons Such As: Sodium fluoroacetate .

Antidotes:

1. **Monacetin (glycol monoacetate)** intramuscularly.

Group VIII Dinitrophenols

For poisons such as: DNOC, DNOCHP.

1. Do Not Use atropine sulfate.
2. Maintain life supports.

Group IX Bromides and Carboxides

For poisons such as: Methyl bromide, Carboxide, Ethylene dibromide.

Antidotes:

1. Barbiturates for convulsions.
2. Cafferine sodium benzoate.
3. Epinephrine for Methyl bromide.

"THE UNIVERSAL ANTIDOTE FOR INSECTICIDE POISONING CONTAINS 7 PARTS OF ACTIVATED CHARCOAL + 3.5 PARTS OF MgO+ 3.5 PARTS OF TANNIC ACID"

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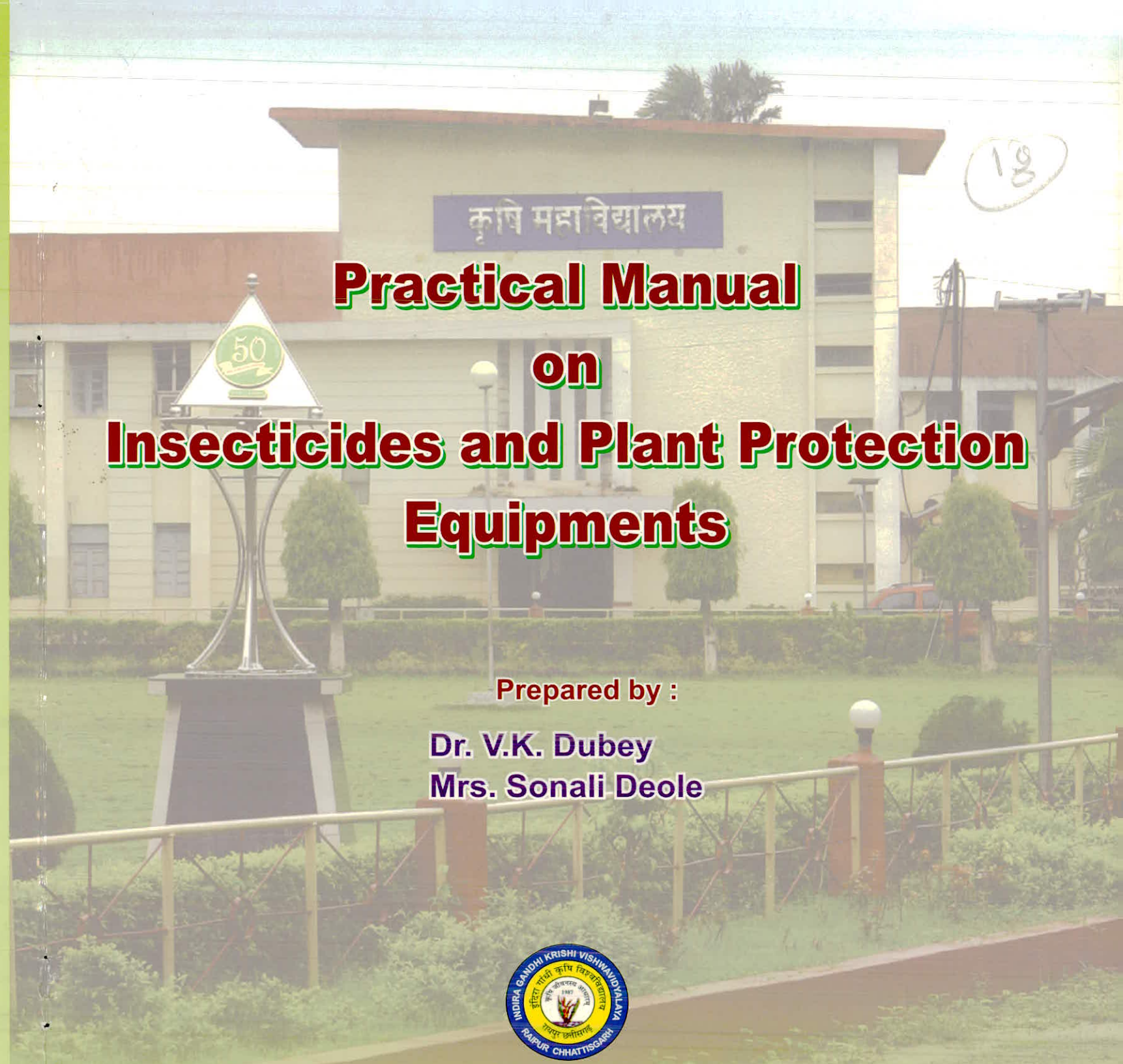
Chhattisgarh Samvad



Practical Manual on Insecticides and Plant Protection Equipments

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