

# MANIDHANAHEYAM FREE IAS ACADEMY – TNPSC GROUP II & IIA

## UNIT - I

### Chemistry - PESTICIDES, FERTILIZERS AND INSECTICIDES

#### 1. FERTILIZERS

- ✓ Introduction and Classification a fertilizer is a substance used to supply essential elements like nitrogen, phosphorous, potassium to the soil. The essential qualities of good fertilizer are as follows.
  - ✓ The nutrient elements present in the fertilizer should be readily available to the plants.
  - ✓ It should not damage the plants
  - ✓ It should be fairly soluble in water so as to enable it to dissolve in soil
  - ✓ It should be stable
  - ✓ It should be able to adjust the acidity of the soil
  - ✓ Fertilizers must to be converted into a form which the plant can assimilate easily
  - ✓ It should be cheap
  - ✓ It should not produce extra heat that can damage the plant

#### 2. Classification of Fertilizer

##### 1. Nitrogenous Fertilizers:

These type of fertilizers generally supply nitrogen to the soil.

**Examples:** Ammonium Sulphate  $[(\text{NH}_4)_2\text{SO}_4]$ , Calcium ammonium nitrate (CAN), basic calcium ammonium nitrate  $\text{Ca}(\text{NO}_3)_2\text{CaO}$ , Calcium cyanamide  $\text{CaNCN}$ , urea etc.

##### 2. Phosphorous Fertilizers:

These fertilizers provide phosphorous to the soil.

**Examples:** Super phosphate of lime, triple super phosphate, phosphate slag, Ammoniated phosphates, Nitro phosphate

##### 3. Potash Fertilizers:

These fertilizers provide potassium to the plant.

**Examples:** Potassium chloride, Potassium sulphate, Potassium Nitrated etc.

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#### 4. NP Fertilizers:

These fertilizers contain two elements i.e., sodium and phosphorous. These are formed by mixing together both the fertilizers.

**Example:** dihydrogen ammoniated phosphate ( $\text{NH}_4\text{H}_2\text{PO}_4$ ), Calcium superphosphate [ $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot 2\text{Ca}(\text{NO}_3)_2$ ].

#### 5. NPK or complete fertilizers:

These type of fertilizers provide all the three essential elements viz nitrogen, phosphorous and potassium to the soil. It is obtained by mixing all the three types of fertilizers in suitable preparations.

### 3. Nitrogenous Fertilizers (12 Marks)

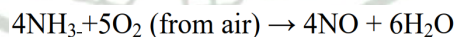
#### 1. Ammonium sulphate or sindri fertilizers ( $\text{NH}_4)_2\text{SO}_4$ :

It is prepared by manufactured at sindri fertilizer factory Bihar. Hence it is called sindri fertilizers. This fertilizer contains 24-25% ammonia which is converted to nitrates in the soil by nitrifying bacteria.

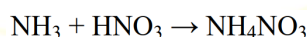
#### 2. Calcium ammonium nitrate (CAN) (Nangal Fertilizer):

[ $\text{Ca}(\text{NO}_3)_2\text{NH}_4\text{NO}_3$ ], It is manufactured in the following manner.

- (i) Production of Ammonia : Haber's process
- (ii) Production of nitric acid: It is obtained by Ostwald's process. This process ammonia mixed with air in the ratio 1: 10 by volume. In this process nitric Oxide (NO) is produced.

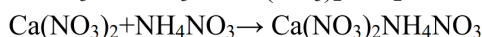
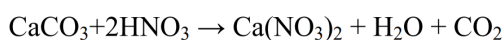


- (iii) Formation of  $\text{NH}_4\text{NO}_3$ :



Ammonium Nitrate

- (iv) Formation of CAN pellets: The concentrates solution of  $\text{NH}_4\text{ON}_3$  is stirred with finally powdered lime stone.



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- (v) CAN is very hygroscopic hence to protect it from atmospheric moisture the pellet of CAN are stirred with concentrated solution of finely powdered soap stone (Sodium Silicate). The pellets are then dried and packed in polythene bags. This fertilizers is manufactured in Mangal (Punjab) and Rourkela. CAN contain 20% nitrogen. It can be directly assimilated by plants, it is highly soluble in water.

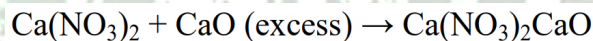
### 3. Basic Calcium nitrate $\text{Ca}(\text{NO}_3)_2 \cdot \text{CaO}$ :

It is manufactured by the following process.

- (i) **Production of calcium nitrate:** When lime stone ( $\text{CaCO}_3$ ) is neutralized by nitric acid and the solution obtained is evaporated when the crystals of  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  are obtained.



- (ii) **Production of  $\text{Ca}(\text{NO}_3)_2 \cdot \text{CaO}$ :** When  $\text{Ca}(\text{NO}_3)_2$  is mixed with excess of quick lime, basic calcium nitrate is obtained.



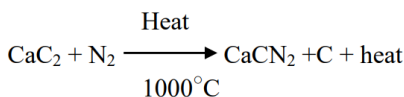
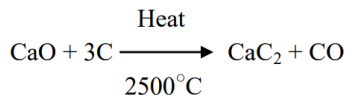
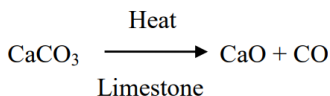
It is hygroscopic and is soluble in water. It is basic in nature and can be directly assimilated by the plants.

### 4. Calcium Cyanamide ( $\text{CaCN}_2$ ):

This compound is a derivative of cyanamide ( $\text{H}_2\text{CN}_2$ ). It is manufactured by the action of air on lime stone and coal. The lime stone is burnt in kilns to obtain lime ( $\text{CaO}$ ). A mixture of lime and coal is heated in an electric furnace at  $2500^\circ\text{C}$  to produce calcium carbide ( $\text{CaC}_2$ ) It is finely powdered and then heated in a cylindrical electric furnace at  $1000^\circ\text{C}$  in the atmosphere of nitrogen, when  $\text{CaCN}_2$  is produced.

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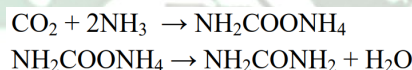
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#### Grey Calcium Cyanamide

It is sparingly soluble in water. This ammonia is converted into nitrates by nitrifying bacteria.

**5. Urea (carbamide NH<sub>2</sub>CONH<sub>2</sub>):** It is an excellent nitrogenous fertilizer and is manufactured by reacting ammonia and carbon-di-oxide.



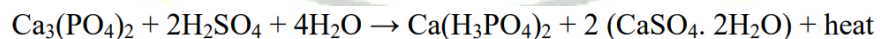
#### Urea

Urea separates as dry powder and contains 47% of nitrogen. Urea has the higher nitrogen content than other fertilizers. Its cost of production is less and it can be used in all types of crops and soils.

#### 4. Phosphate Fertilizers (12 Marks)

##### 1. Super phosphate of lime [Ca (H<sub>2</sub>PO<sub>4</sub>)<sub>2</sub> + 2 (CaSO<sub>4</sub>. 2H<sub>2</sub>O)]:

It is a mixture of calcium dihydrogen phosphate Ca (H<sub>2</sub>PO<sub>4</sub>) and dihydrate calcium sulphate (gypsum) CaSO<sub>4</sub> 2H<sub>2</sub>O. It contains about 16-20% of P<sub>2</sub>O<sub>5</sub>.



Calcium dihydrogen + gypsum Phosphate Super Phosphate of Lime

##### 2. Double and Triple Superphosphates:

Triple phosphate is prepared by treating rock phosphate with phosphoric acid in a mixer.



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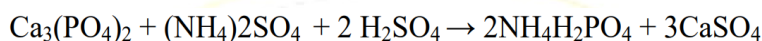
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#### 3. Phosphatic Slag:

This slag is obtained as a byproduct in the manufacture of steel and is a double salt of tricalcium phosphate and calcium silicate.

#### 4. Ammoniated phosphate:

It is prepared action of calcium phosphate, sulphuric acid and ammonium sulphate. It contains about 12% of nitrogen and 50.5% of P<sub>2</sub>O<sub>5</sub>.



#### 5. Potash fertilizers (6 Marks)

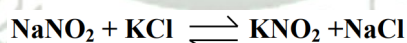
##### 1. Potassium chloride:

It is found in nature as Sylvine (KCl) and carnalite (KCl. MgCl.6H<sub>2</sub>O). It is extracted from carnalite by boiling with the mother liquor from previous operation. Carnalite dissolves where as other impurities are not dissolved and can be filtered off. It is a white crystalline solid and is fairly soluble in water.

**2. Potassium sulphate (K<sub>2</sub>SO<sub>4</sub>):** It is manufacture from naturally occurring mineral. Eg. Schonite



**3. Potassium nitrate or Nitre or Indian Saltpetre (KNO<sub>2</sub>):** Crude Nitre occurs as an efflorescence on the surface of the earth in tropical countries. It is obtained from a mixture of child % petre (NaNO<sub>2</sub>) and potassium chloride (KCl).



#### 6. PESTICIDES

Pesticides are legally classed as 'Economic poisons' and are defined as any substance used for controlling, preventing, destroying, repelling or mitigating any pest.

##### Lists the various Pesticides

S.No	Pesticide class	Functions
1	Insecticide	Controls Insects
2	Herbicide	Kills weeds
3	Fungicide	Kills fungi

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4	Rodenticide	Kills Rodents
5	Bactericide	Kills Bacteria
6	Algicide	Kills Algae
7	Molluscicide	Kills Snails, Slugs, Mussels, Oysters
8	Avicide	Controls or repels birds
9	Slimicide	Controls Slimes
10	Piscicide	Controls Fish
11	Ovicide	Destroys Eggs

**7. Classification (on the basis of the method by which insecticides act)**

**(6 Marks)**

**1. Contact Poison**

Those which kill by direct action on the organism are designated as contact poison. Examples: Chlorinated hydrocarbons, organophosphates, carbonates, pyrethrum, Nicotine sulphate, Rotenone.

**2. Stomach Poison**

Those which act internally after ingestion by the insect are termed as Stomach Poison. Compounds of Arsenic and fluorine are used as stomach poisons. Examples: Lead Arsenate, Calcium Arsenate, Copper Arsenate, cryolite. Sodium fluoride, sodium, barium fluosilicates, Mercury compounds such as  $HgCl_2$ , boron compounds (boric acid), thalium compound ( $Tl_2SO_4$ ), yellow phosphorous and formaldehyde.

**3. Fumigants**

Insecticides which acts in Gaseous state are called fumigants. Examples: HCN gas. Methyl bromide, carbontetrachloride, carbondisulphide, nicotine, naphthalene

**8. Insecticides (12 Marks)**

The control of insect pests affecting agricultural crops, domestic animals and man has been of considerable economic importance to mankind since the beginning of civilization.

**1. The Arsenic Compounds Arsenic Oxides:**

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Arsenic tri oxide  $As_2O_3$ , Arsenic pentoxide or Arsenic acid  $As_2O_5$ .

**Calcium Arsenates:**  $Ca_3(AsO_4)_2$   $Ca(OH)_2$

**Lead Arsenates:**  $PbHASO_4$

**Magnesium Arsenates:** Mono magnesium ortho Arsenate  $MgH_4(AsO_4)_2$ , secondary magnesium ortho Arsenate  $MgHASO_4$  and Tri magnesium ortho Arsenate  $Mg_2(AsO_4)_2$

### 2. Fluorine Compounds

**Sodium Fluoride (NaF):** The first Fluorine compound used against cockroaches. It is also used as Herbicide.

**Zinc fluoride ( $ZnF_2$ ):** Used as wood Preservative.

Calcium Fluorspar, magnesium, Strontium, Copper, barium and lead fluorides are tested against mosquito larvae.

- ❖ Sodium and potassium fluosilicate  $Na_2SiF_6$  and  $K_2SiF_6$  are used against mosquito larvae.
- ❖ Sodium aluminium fluosilicate, Sodium fluo aluminates  $Na_3AlF_6$

### 3. Boron Compounds

- (i) Boric acid ( $H_3BO_3$ ) has been used as an ingredient of cockroach baits and to kill housefly larvae in manure.
- (ii) Borax ( $Na_2B_4O_7 \cdot 10H_2O$ ): It is used as fly preventive in manure and ant poison
- (iii) Barium and Calcium borates

### 4. Mercury compounds

Metallic mercury has been found to function as a fumigant.

- (i) Mercuric chloride  $HgCl_2$ : It has been used as fungicide and Bacteriacide.
- (ii) Mercuric oxide  $HgO$
- (iii) Ethyl mercuric chloride ( $C_2H_5HgCl$ ), Ethyl mercuric Iodide – ( $C_2H_5HgI$ ) and Ethyl mercuric phosphate.
- (iv) Phenyl mercuric salts ( $C_6H_5HgX$ ): Acetate, Benzoate, phthalate, Salicylate, Gluconate
- (v) Hydroxy mercurichlorophenol, hydroxy mercuricresol.

### 5. Copper Compounds

- (i) **Bordeaux mixture** ( $CuSO_4 + Ca(OH)_2$ )

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Solution made up of copper sulphate, quick lime and water in fixed ratios. It is used as Fungicide.

### (ii) Burgundy mixture:

It is known as soda Bordeaux and is prepared by the reaction of copper sulphate, pentohydrate and sodium carbonate solution.

### 6. Sulphur Compounds

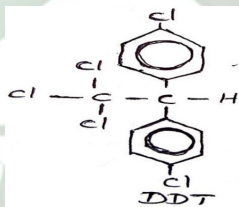
Sulphur dioxide (SO<sub>2</sub>) is used as household fumigant.

### 9. Modern Insecticides (12 Marks)

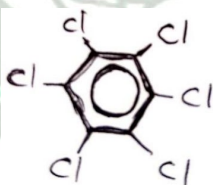
#### 1. Organo Chlorine Insecticides

(i) DDT: Dichloro Diphenyl Trichloro Ethane

DDT is prepared from Chloro Benzene and trichloro acetaldehyde



(ii) BHC (Benzene Hexa Chloride)



(iii) DDD (Dichloro Diphenyl Dichloro Ethane)

(iv) Lindane

(v) Endosulfan

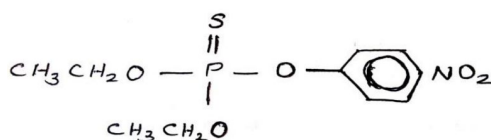
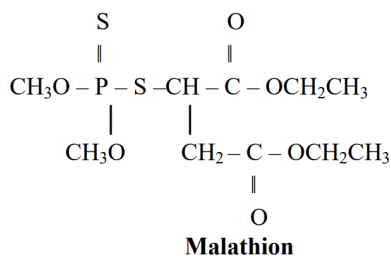
#### 2. Organo Phosphorous Insecticides

Organo Phosphorous Insecticides are Malathion, Parathion, TEPP, Thimet, Tetram, Phosdrin, and Paraoxon HETP.

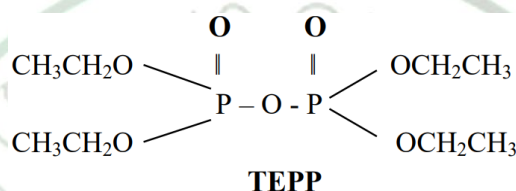


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Parathion



### 3. Carbamate Insecticides

Carbamate Insecticides are Carbarb (Sevin), Aldicarb (? Temik), Penuron, Monuron, Sactron.

### Some Important Herbicides and Rodenticides

#### Some Important Herbicides

Some important Herbicides are 2, 4 D (2, 4 dichlorophenoxy acetic acid), 2, 4, 5 - T (2, 4, 5 tri - chlorophenoxy acetic acid), atrazine, picloram, propazine.

#### Some Important Rodenticides

Some important Rodenticides are Strychnine, Arsenic, Zinc phosphate, warparin, sodiul fluoro acetate, thalium phosphorous, ANTU (alpha naphthyl urea) and Norbromide.