Fertilizers

* Chemicals used to Provide for of make up for the deficiency of the Primary nutrients in Soil are called fertilizers or chemical fertilizers.

* Nitrogen, Phosphorus and Potassium are the essential elements required for the growth of plants. These three elements are called primary Nutrients.

Need for fertilizers:

* To Supplement what has been eaten by the plants.

* To give them an additional supply of tonic and good food so that they may grow more healthy and Produce a better yield (i.e,) the soil has to fertilized and

* The fertilizers help maintain the PH of the Soil in the vicinity of 7 to 8, and thereby facilitate optimum growth and health.

Requisites of a good fertilizer:

* It should Contain nutrient elements in readily available form.

* It should be soluble in water.

* The nutrients elements in it should be available to the plants for a long period. i.e, It should be stable.

* There should be nothing which harms the plants.

* It should be cheap.

Role of N, P and K in soil:

Nitrogen gives dark green colour to the plants. It helps rapid growth of the plant. It increases Protein content and the yield of crops. Phosphorus helps the early formation of roots, growth flowering and seed formation. Pottasium Provides sufficient resistance to diseases in plants. It increases the quality of seed. It assists in formation of Carbohydrates.

Npk and Mixed fertilizers:

Nitrogen:

It is supplied in the form of nitrates, ammonium compounds, urea, Calcium cyanamide etc.

1) Ammonium nitrate:

Ammonium Nitrate is Prepared by the action of NH_3 gas with HNO_3. NH_3 obtained from Haber's process is first oxidised to HNO_3. It is neutralised by NH_3 to NH_4NO_3 which is subsequently crystallised.

$$HNO_3 + NH_3 \longrightarrow NH_4NO_3$$

It absorbs moisture readily. So the granules or pellets of ammonium nitrate are coated with a water proof material to facilitate its handling.

Advantages:

* It has a high nitrogen content (33%)
* Less expensive to transport than $(NH_4)_2SO_4$.
* Highly soluble in water.
* It provides both Mobile NO_3-N and immobile NH_4^+ ions. (NH_4^+ will be absorbed by soil particles).

Disadvantages: i) it explodes ii) it is deliquescent.

2) Ammonium Sulphate:

They Synthetic ammonia (from Haber Process)

is adsorbed in sulphuric acid and the solution is evaporated to dryness. We get ammonium sulphate.

Sindri Process: Synthetic ammonia gas is passed into a suspension of finely powdered $CaSO_4$ (obtained from gypsum) in water through which CO_2 is also passed.

$$2NH_3 + H_2O + CO_2 \longrightarrow (NH_4)_2CO_3.$$

$$CaSO_4 + (NH_4)_2CO_3 \longrightarrow CaCO_3 \downarrow + (NH_4)_2SO_4.$$

* The precipitated $CaCO_3$ is filtered off. The filtrate is concentrated by evaporation under vacuum. On cooling, crystals of $(NH_4)_2SO_4$ are got. The crystals are dried, packed and sold under the name Sindri fertilizer.

* The production of ammonium sulphate in India is on the increase. The main manufacturing centres are at Sindri, Durgapur, Jamshedpur, Bhilai, Alwaye etc..

Uses / Role as fertilizer to plants:

* Ammonium sulphate is particularly useful with paddy (rice). This plant appears to prefer N in NH_4^+ form. Since it is held by the clay particles it will not leach. This is important in paddy soils

Which are under Water for such long Periods. The anaerobic conditions in Paddy soil Preserve the NH_4^+ form and conversion on NO_3^- Will take Place only to a slight extent.

Disadvantage:

* Low Nitrogen Content (20 % N)
* Higher transportation cost.
* It is an acid forming material in the soil.

NH_4^+ ions undergo oxidative nitrification in the soil resulting in the formation of HNO_3 and excess of H^+ ions which combine with SO_4^{2-} forming H_2SO_4.

3, Urea:

* It is manufacted by reacting liquefied NH_3 with liquified CO_2 at 170 - 200°c and 100 - 300 atmosphere Pressure. First ammonium Carbonate $H_2NCOONH_4$ is formed. Then it decomposes under Pressure giving urea and Water. Than urea solution is concentrated in vacuum evaporators. The molten urea is than rapidly cooled and solidified. It is

$$2NH_3 + CO_2 \rightleftharpoons H_2NCOONH_4 \rightleftharpoons CO(NH_2)_2 + H_2O$$

being manufactured in Sindri, Nangal and Kota.

Uses :

It is an excellent nitrogenous fertilizer

Advantages :

i) It has some advantages over other fertilizers in the nitrate form or NH_4^+ form. If $(NH_4)_2SO_4$ is used, the plants use N from NH_4^+ and SO_4^{2-} is left behind in the soils which forms H_2SO_4. So the acidity of the soil increases as days pass on. On the other hand, urea is converted by moist soil into $(NH_4)_2CO_3$ by a naturally occurring enzyme in the soil called urease. The plants use N from NH_4^+ and CO_3^{2-} is left behind in the soil. Thus when urea is used, the soil does not become acidic as in the case of ammonium sulphate. So urea is better than ammonium sulphate.

ii) The nitrogen content of urea is high (45%) [More than that in CAN and $(NH_4)_2SO_4$].

iii) Transportation and packing charges less

iv) cost of production is less

v) It does not explode like NH_4NO_3 so it can be stored without risks.

vi) It does not change the pH of soil. So it can be used to all types of crops and soils.

Disadvantages:

* Urea is very soluble in water and hygroscopic. So packing should be better and hence packing cost is higher than $(NH_4)_2SO_4$.

* It is less stable than other solid nitrogenous fertilizers. This is because it decomposes to NH_3 and CO_2 even at lower temperatures particularly in humid atmosphere.

* If the impurities exceed 2% urea becomes useless as impurities are toxic to certain crops [E.g - Citrus crops].

Disadvantages: Calcium Ammonium Nitrate:

4) [CAN] or Nargal fertilizer [$Ca(NO_3)_2 . NH_4NO_3$]:

Nitrogen from air is converted into ammonia by Haber Process. A part of ammonia is converted into nitric acid by Ostwald's process. Nitric acid is then reacted with the remaining ammonia. We get ammonium nitrate.

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3.$$

The solution of NH_4NO_3 thus obtained contains some HNO_3 also. To this solution some lime stone ($CaCO_3$) is added where by Calcium Ammonium nitrate (CAN) is got.

$$2HNO_3 + CaCO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$$

$$Ca(NO_3)_2 + NH_4NO_3 \longrightarrow Ca(NO_3)_2 + NH_4NO_3$$

CAN.

NH_4NO_3 is an explosive material. So to make it safe for handling, it is treated with $CaCO_3$. The pellets of CAN are coated with soap-stone (Calcium silicate) to protect them from moisture. CAN is manufactured at Nangal and Rourkela.

Uses:

* It is a good nitrogenous fertilizer. It contains

about 20% N

Advantages:

* Directly assimilated by plants and does not undergo any change in the soil.

* It is highly soluble in water. It finds its way as such into the soil, very easily.

Disadvantages:

* It is very hygroscopic. So it has to be protected from atmospheric moisture during its transportation and storage by coating the pellets of CAN with soap stone.

* Its nitrogen content is low.

Phosphorus:

It is supplied in the form of phosphate.

1. Super Phosphate of lime or calcium Super Phosphate:

$[Ca(H_2PO_4)_2 H_2O + 2CaSO_4 \cdot 2H_2O]$:

* It is a mixture of primary calcium phosphate and gypsum. It is prepared on a large scale by treating $Ca_3(PO_4)_2$ obtained from phosphorite rock or bone ash with calculated quantity of 70% H_2SO_4. The phosphorite rock contains impurities like $CaCO_3$ and CaF_2.

These react with H_2SO_4 giving out CO_2 and HF which are gases. These gases escape from the reaction mass rendering it porus. So drying and pulverising becomes easy.

$$Ca_3(PO_4)_2 + 2H_2SO_4 + 5H_2O \longrightarrow CaCH_2PO_4)_2 + H_2O + 2CaSO_4 \cdot 2H_2O.$$

The solid Product including gypsum is crushed to a fine powder and sent for direct use or Mixed with Nitrogen and potash fertilizers to make Npk fertilizer.

Uses as fertilizer:

It contains about 20% P_2O_5 Its active ingredient is calcium dihydrogen phosphate. This is Soluble in water. Thus it Provides phosphate in a Water Soluble form which is readily assimilated by plants for their growth.

Disadvantages:

* Its P_2O_5 content is low
* Transportation and Packing are costly.
* It gets into big lumps on keeping (iv) It is acidic. Hence it is corrosive so the Package is spoiled and

the fertilizer spills over causing wastage.

Triple Super phosphate :

It is almost pure $Ca(H_2PO_4)_2$.

Preparation :

Ground rock Phosphate is mixed with requisite quantity of H_3PO_4 in a mixer and agitated for several hours. The dried triple superphosphate is screened by vibrating screens, and then is made ready for sale.

$$Ca_3(PO_4)_2 + 4HBPO_4 \longrightarrow 3Ca(H_2PO_4)_2$$

Use as fertilizer :

It has about 50% available P_2O_5. It is three times more concentrated phosphate manure than calcium Calcium Superphosphate. It is an excellent phosphatic fertilizer. This is more superior than Super-phosphate of lime because it does not contain gypsum, which is water insoluble.

Potassium :

It is supplied in the form of Chloride, nitrate and Sulphate.

Potassium chloride :

It occurs in nature as Sylven (KCl) and Carnollite ($KCl\ MgCl_2\ 6H_2O$). Carnollite contains NaCl and $MgSO_4$ as impurity. The Carnollite is ground and extracted with a 20% Solution of $MgCl_2$. The Carnollite passes into Solution. NaCl and $MgSO_4$ remain undissolved. The clear Solution is allowed to run into Crystallization tanks and allowed to cool when crystals of KCl separate out. The mother liquor after the separation of these crystals contains only $MgCl_2$ it is used for fresh extraction.

Potassium Nitrate - Saltpetre KNO_3 :

In the neighbourhood of Indian villages, the ground becomes saturated with the nitrogenous compounds contained in crude sewage. Under the action of certain bacteria, nitrification takes places and nitrates are formed. Such soil is removed, extracted with water and the salt is crystallised out. further purification is done by repeated crystallisation.

Potassium Sulphate K_2SO_4 :

A Solution of caustic alkali is neutralised with Sulphuric acid. First the acid Sulphate, $KHSO_4$ is formed. When more alkali is added, the Sulphate, K_2SO_4 is

formed. It is obtained as a by product in the manufacture of $K_2Cr_2O_7$ and $KHNO_4$.

Mixed fertilizers:

Mixed fertilizers are those which contain two or all the three primary nutrients. These fertilizers are coming into prominence now-a-days.

Phosphatic cum Nitrogenous fertilizers:

These are mixed fertilizers which supply both Nitrogen and Phosphorus to the soil.

1. Ammoniated Super phosphate:

It is obtained by spraying a solution of ammonium nitrate and ammonia on super phosphate contained in a revolving drum. Ammoniated superphosphate is easier to store. It does not damage the jute bags in which it is packed.

2) Calcium Superphosphate nitrate:

It is obtained by treating phosphorite rocks with nitric acid.

$$Ca_3(PO_4)_2 + 4HNO_3 \longrightarrow Ca(H_2PO_4)_2 + 2Ca(NO_3)_2$$

Calcium superphosphate nitrate.

3. Ammonium phosphate Sulphate:

It is obtained by neutralising a mixture of Phosphoric acid and Sulphuric acid by ammonia gas.

$$3NH_3 + H_3PO_4 + H_2SO_4 \longrightarrow (NH_4)H_2PO_4 + (NH_4)_2SO_4$$

Ammonium Phosphate Sulphate.

4. Mono ammonium Phosphate:

Gaseous ammonia is reacted with crude Phosphoric acid. we get mono ammonium phosphate.

$$H_3PO_4 + NH_3 \longrightarrow (NH_4)H_2PO_4$$