CHAPTER 3

TREATMENT FERTILIZERS

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Plants require large supply of compounds like nitrogen, phosphorus, potassium, calcium, magnesium and sulphur. The first three are the major nutrient elements, hence are chief components of the fertilizers. Application of fertilizers and the breeding of new strains together constitute the agricultural technology, which has done wonders in Europe, Japan and United States, in the area of food production. The use of fertilizers is not only necessary because of their importance to plants but also as the scientific strategy to keep pace of the food production with the exponential growth of human population. Nitrogen, phosphorus and potassium are also most commonly deficient in soil and their artificial inputs are needed to maintain the fertility of the agricultural soil.

3-1 Classification of fertilizers:

Fertilizers are classified in simple manner — fertilizers providing nitrogen are called 'nitrogenous' fertilizers, those supplying phosphorus are called 'phosphatic' fertilizers and those providing potassium are called 'potassic' fertilizers. These fertilizers may be either (i) "Straight Fertilizers"
or (11) "Compound Fertilizers" (Handbook of manures and fertilizers, 1971). Straight fertilizers contain only one plant nutrient as distinguished from compound fertilizers which have two or more plant nutrients. In India, most of the fertilizers are used as straight materials. However, some fertilizer mixing companies have introduced compound fertilizers as well.

3-2 Nitrogenous fertilizers:

Among the nitrogenous fertilizers ammonium sulphate and urea are most popular. Urea has a positive advantage over ammonium sulphate, as it contains more than double percentage of nitrogen than that in ammonium sulphate. In India, this fertilizer is manufactured at the Sindri, Neyveli, Rourkela and Bombay (Handbook of manures and fertilizers, 1971).

3-3 Phosphatic fertilizers:

Phosphatic fertilizers are either water soluble or citrate soluble. Among the water soluble phosphatic fertilizers, the single superphosphate is most common in use of all the phosphatic fertilizers (Handbook of manures and fertilizers, 1971).
3-4 Potassic fertilizers:

The chief sources of the potassic fertilizers are the mineral cannallite, kainite, langbeinite and sylvite. Of these fertilizers, the chief commercial ones are, muriate and sulphate of potash. The others are relatively of very little importance (Handbook of manures and fertilizers, 1971). The manufacture of muriate of potash from salt bittern is being taken up at the Central Salt Research Institute, Sambhar, Rajasthan. However, because of increasing requirements of these fertilizers, part of them is imported from abroad.

3-5 Compound fertilizers:

Compound fertilizers are becoming increasingly popular in India, particularly in Southern regions. There are several advantages in the use of fertilizer mixture. In labour scarce areas, there is a saving in the cost of application of fertilizers. 'Gromor', the fertilizer included in this study, is a mixture of urea and ammonium phosphate and is quite popular in Central India.

3-6 Urea:

The relevant aspects of the chemical composition of
these fertilizers and their manufacturing processes are described as below:

Urea (carbamide), $\text{CO,} (\text{NH}_2)_2$, is a highly concentrated form of nitrogen with 45-46% of non-protein organic nitrogen. It is freely soluble in water and when applied to soil its nitrogen is rapidly changed to ammonia. It is applied at the sowing time, as top dressing, and in the form of foliar sprays (Handbook of agriculture, 1969). The nitrogen of the fertilizer becomes available on the hydrolysis of the fertilizer by urease enzymes in the soil. Until urea is hydrolysed, it is not adsorbed on the soil particles and moves rapidly with percolating water. Therefore, immediate irrigation, after urea application, is generally not recommended (Randhawa, 1974). Loss of urea nitrogen may be occasioned if anaerobic conditions prevail in the soil during the process of decomposition. Under such conditions ammonia will escape from soil. Cultivation of soil, prior to deep application of the fertilizer in the reduced layer, is helpful in making available larger amount of the nitrogen from this fertilizer.

Process of manufacture:

Ammonia fertilizers and urea are manufactured mostly by the modified Claud-Haber ammonia synthesis. The Claud-Haber ammonia synthesis process consists of directly combining
nitrogen and hydrogen to form ammonia. The synthesis of nitrogen and hydrogen is carried out in the presence of catalysts, such as osmium, iron and platinum at temperatures ranging from 400-500°C at pressure range of 200-1,000 atmosphere. The hydrogen is mostly prepared by reforming natural gas, principally methane, with steam over a nickel catalyst. The urea is manufactured by reacting carbon dioxide and anhydrous ammonia under very high pressure and temperature. The unreacting ammonia and carbon dioxide are recycled. The urea solution is centrifuged and after mixing with conditioning agent is passed through a mixer dryer to be bagged (Handbook of manures and fertilizers, 1971).

3-7 Muriate of potash:

This is potassium chloride. This fertilizer contains 50-63% of potash (K₂O), the whole of which is readily available (Handbook of agriculture, 1969). Because of the solubility of potassium chloride, the fertilizer is susceptible to leaching losses. It is, therefore, recommended to apply small quantities of this fertilizer in piecemeal operations (Randhawa, 1974). The colloidal particles of clay and humus in the soil have a remarkable power of adsorbing the potassium ions from the solutions of the potassium salts (Vanstone, 1947).
Process of manufacture:

Cannellite and sylvite are two minerals from which muriate of potash is obtained. The potash salts are mixed by explosives and scraping. Modern conveyor and transport systems bring the salt to the raw salt-grinding plant. The fertilizer is ultimately lifted to the factory aboveground. It is then refined by making well-planned use of physico-chemical equilibrium of salt solution and fractional crystallization.

This fertilizer is also produced by salt bittern and brines.

3-8 Single superphosphate:

This is monocalcium phosphate with the formula $\text{Ca}\left(\text{H}_2\text{PO}_4\right)_2$. Single superphosphate contains 16-20% phosphoric acid (Handbook of agriculture, 1969). As stated earlier, the phosphoric acid turns into water insoluble compounds in the soil and the so-called coefficient of phosphorus utilization, therefore, does not exceed 20-30% of the fertilizer content (Lysenko, 1957). Haskell (1923) concluded that a localized application of superphosphate is more beneficial and economical than broadcast distribution. Superphosphates in solution do not travel far from the place
of application, that is why the fertilizer is not applied as
top dressing. Leguminous crops, which have capacity to fix
atmospheric nitrogen, need more of water-soluble phosphatic
fertilizers. Phosphates promote the growth of nitrogen
fixing bacteria and, therefore, help in nitrogen fixation
(Gromor Newsletter, 1975).

Process of manufacture:

Superphosphate was first manufactured from bones by
digesting them with half their weight of sulphuric acid
diluted with three or four parts of water. Later on, rock
phosphate was used instead of bones (Handbook of manures and
fertilizers, 1971). A modern superphosphate plant consists
of conveyors which move the ground rock phosphate from the
mill to the storage site. From there, it is conveyed to the
mixer and ultimately fed to the mechanical den. The
superphosphate is excavated from the den by a revolving
knife. It is then lifted up and carried to disintegrators
and then filled up in bags. In India, all the superphosphate
manufacturing concerns use rock phosphate imported from
Morocco. Singhbhum rock phosphate is mixed to a small extent
and is mostly processed for use as direct raw material
fertilizer.
3-9 'Gromor' 28-28-0:

The compound fertilizer, 'Gromor', consists of Nitrogen and Phosphate (N₂ and K₂O₃) in 1:1 ratio without potash (K₂O). Chemically this fertilizer is urea ammonium phosphate. The urea hydrolyzes to ammonium carbonate, which decomposes into ammonia and carbon dioxide. This, along with ammonical nitrogen present, is either utilized by plants as ammonia or nitrate after nitrification. The phosphates in the fertilizer are in water soluble form (Gromor Newsletter, 1975). Since nitrogen and phosphorus are combined in a complex form, the uptake of both these nutrients is more than when they are applied separately. This is because combined nitrogen keeps the phosphates in water soluble form, for longer periods, and makes it diffuse to greater distances. In a personal communication the Chief Agronomist, Coromandel Fertilizers Ltd., has submitted the report on the physical and chemical characteristics of 'Gromor' (28-28-0). According to this report, the fertilizer contains 9% of ammonical nitrogen, 19% of amide nitrogen, 28% of available phosphates and about 5% of impurities and secondary materials like iron, calcium, magnesium, sulphate and chloride.