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Significance And Classification of Mineral Fertilizers

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Anotation: There is a strong raw material base in our country, which is able to entirely providing the demands of economy in mineral resources. The large reserves of raw materials allowed operating the leading enterprises of the chemical industry such as Almalyk "Ammofos-Maxam" JSC, "MaxamChirchik" JSC, "Ferganaazot" JSC, "Navoiyazot" JSC, "Tashkent Paint Factory" JV, Dehkanabad potassium fertilizers plant" UE, "Kungrad soda plant" UE, "Shurtan gas chemical complex" LLC, "Kungrad sodium sulfate" JV and a number of other chemical enterprises. Currently, large chemical enterprises operate in Almalyk, Chirchik, Fergana, Kokand, Navoi, Shurtan, Dehkanabad and other regions of the country.

Agricultural crops area cover about 13% of the Earth surface. It is impossible to expand the area under crops. Nevertheless, the population of our planet is constantly growing, and it is necessary to further increase productivity to provide them with food. One of the most important ways of this is using mineral fertilizers. Fertilizer is a substance designed to improve plant nutrition and increase soil fertility.

Key words: Mineral fertilizers, macroelements, bmicroelements, Phosphorus Potassium, Organic fertilizers, Liquid fertilizers, Fertilizers, Prolonged, concentrated, highly concentrated, micro-fertilizers, Micronutrients

Mineral fertilizers are salts and other inorganic, industrial and mineral products that contain elements necessary for plant development and soil fertility and are used for stable and high yields.

More than 70 chemical elements are involved in the formation of plant tissue, its growth and development. The most important of these are carbon, oxygen, and hydrogen, which make up 90% of the dry mass of a plant; the most important of which are carbon, oxygen, and hydrogen, which make up 90% of the total mass of the plant; nitrogen, phosphorus, potassium, magnesium, sulfur, sodium and calcium make up 8-9% of the plant mass. These ten elements are called *macro-elements*. The remaining 1-2% is iron, copper, manganese, zinc, molybdenum, cobalt and others. These plants need very small amounts (0.001-0.0001%). That is why they are called *microelements.*

Plants obtain most of the carbon, oxygen, and hydrogen from air and water, while they obtain the rest from the soil. Most of the elements that the plant receives do not return to the soil, but are removed by the crop. For example, 1 ton of corn carries 14 kg of nitrogen, 2.5 kg of phosphorus, 3.5 kg of potassium, 1.5 kg of sulfur from the soil. Much of the soil elements are washed away by water and interact with soil components to make the plant unable to assimilate. As a result, there is a shortage of plant nutrients in arable lands, and soil fertility decreases. If fertilizers do not replace these lost elements, the yield will drop sharply.

Therefore, great attention is paid to the production of fertilizers. The use of fertilizers allows increasing the yield of agricultural crops by 50-60%. For example, about a quarter of the food on the planet and about half of the cotton is obtained only from fertilizers. The nutrients in fertilizers, especially nitrogen, play a major role in the mineral nutrition of plants (Table 1). It is a component of proteins and nucleic acids. Nitrogen is also a component of photosynthesis in plants, i.e. chlorophyll, which plants use to synthesize organic matter from inorganic substances.

Phosphorus plays a major role in plant respiration and reproduction. It contains substances (enzymes, vitamins, etc.) that are important in the life of the plant. In particular, it contains complex protein-nucleoproteins found in seeds.

Chromosomes that preserve and pass on hereditary traits are made up of nucleoproteins. Phosphorus plays a key role in the high grain content of cereals. It increases the resistance of plants to cold, drought and has a positive effect on the reproduction of essential nutrients. For example, it leads to an increase in starch in potatoes and sucrose in sugar beets.

Potassium plays an important role in regulating the vital processes that take place in the plant. It improves the water regime in the plant, is involved in the formation of carbohydrates and metabolism. Dry

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plant stems contain up to 4-5% of potassium, and the ash from the burning of leaves contains up to 30-60% of potassium.

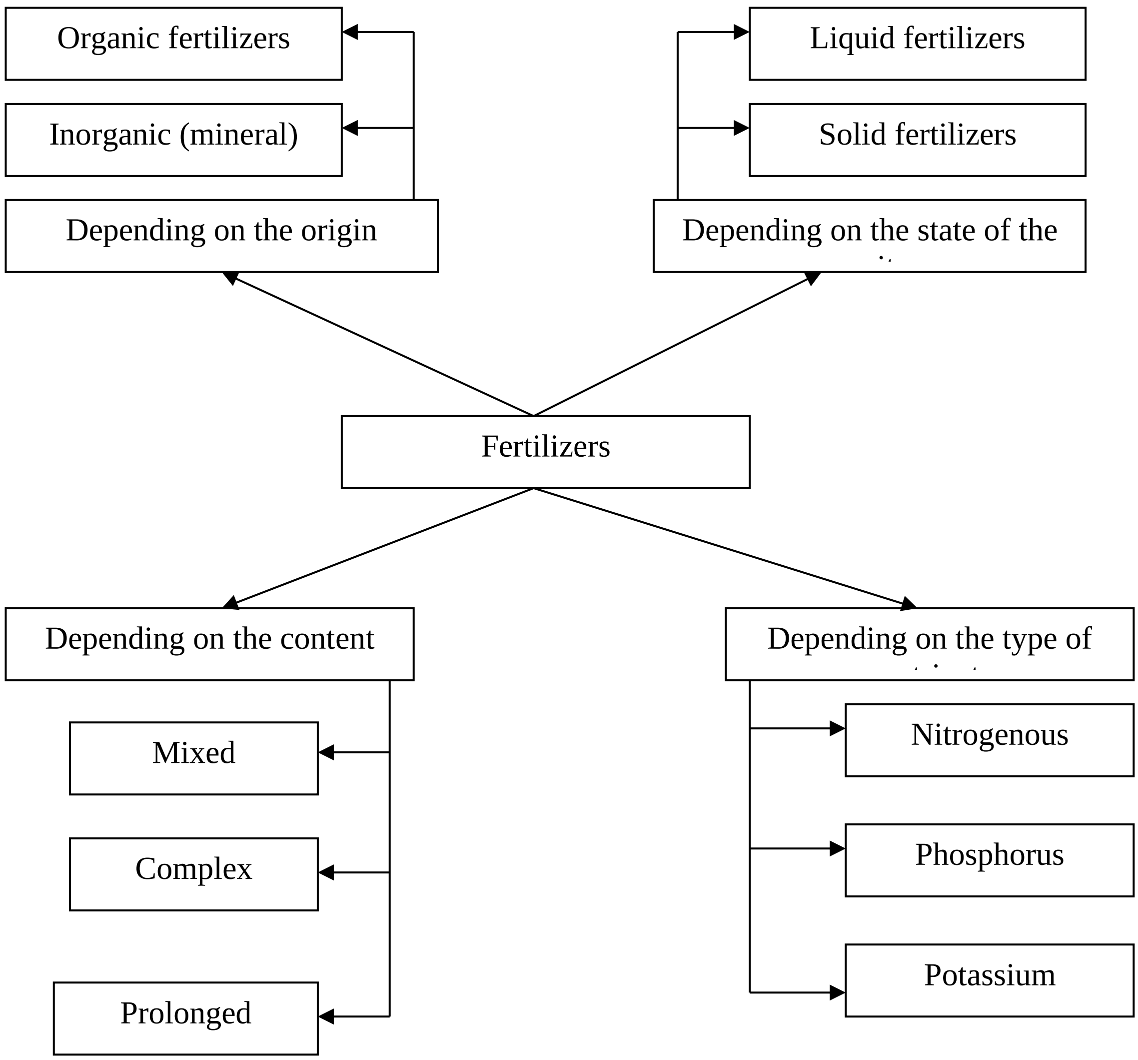

Table 1. Fertilizer classification

Mineral fertilizers are mainly used in agriculture, for planting in crops in order to increase productivity. The second major industry where fertilizers are used is the chemical industry. In particular, sodium and potassium salts, such as Cl, KCl. Soda, hydrochloric acid, potash, caustic soda, caustic potash are raw materials for production. Na2SO4 is a raw material in the production of glass, sodium sulfide, fluoride, potassium and sodium dichromate, sodium phosphate.

In metallurgy, fertilizers are used in ore beneficiation, liquefaction of metals, and extraction of metals by electrolysis, metal surface treatment, welding of metals and alloys. In particular, sodium sulfate is the main raw material in the production of glass.

Classification of fertilizers

Fertilizers are divided into classes depending on the origin, field of application, composition, properties and methods of obtaining. All fertilizers are divided into two:

1) direct (used for plant nutrition);

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Date of Publication:13-02-2022

2) indirect (used for chemical amelioration of soil, pH correction) fertilizers.

Depending on their origin, fertilizers are divided into *mineral, organic, organic-mineral and bacterial fertilizers*. Mineral fertilizers are mainly mineral salts (but they also include organic matter urea). Organic fertilizers include manure, peat, green plants, compost, feces, etc. Bacterial fertilizers contain microorganisms that accumulate nutrients in the soil that the plant can assimilate. For example, the enzyme nitrogenase of endogenous bacteria accumulates atmospheric nitrogen as a compound, or phosphobacteria, which break down organic compounds, make the phosphorus in organic compounds available to plants. There are $4 \cdot 10^{15}$ tons of nitrogen in the Earth's atmosphere, i.e. 80 thousand tons of nitrogen in the air per 1 ha. This is a million times more nitrogen than 1 ha planted in the ground. The reaction of nitrogen bacteria living in legumes when they attach atmospheric nitrogen can be summarized as follows:

$$2N_2 + 6H_2O + 3C + 356\ kJ = 4NH_3 + 3CO_2$$

In this way, up to 50 kg of bound nitrogen per year falls from 1 hectare of arable land. Lightning strikes in the air also cause up to 15 kg of nitrogen per hectare per year.

Mineral fertilizers are divided into phosphorus, nitrogen, potassium, magnesium, barium and other fertilizers depending on the composition. Depending on the number of nutrients in the fertilizer, fertilizers are divided into two types: simple or one-component (contains one element that the plant absorbs) and complex (contains two or more elements).

Complex fertilizers are divided into complex and mixed fertilizers. Complex fertilizers are a single chemical compound that contains at least two or more plant-absorbing elements. Mixed fertilizers are obtained by mechanical “mixing” of simple or complex fertilizers. Fertilizers contain more than 33% of active substance, ***concentrated***, more than 60% is called ***highly concentrated***.

In addition to the 10 elements mentioned above, chemical elements such as B, Cu, Co, Mn, Zn, Mo, I are required in very small quantities. They are micronutrients, and fertilizers that contain such elements are called micronutrients. Now it is impossible to work without ***micro-fertilizers***, because their use creates additional opportunities in agriculture.

Micronutrients not only increase the productivity of plants, but also increase their resistance to disease. Micronutrients accelerating biochemical processes in the plant body, increasing the activity of enzymes, increasing the synthesis of proteins and nucleic acids, vitamins, sugars and starch. Micronutrients are applied up to 1 kg per 1 ha of land.

Depending on the state of the aggregate, fertilizers are divided into solid, liquid (e.g., aqueous solution and suspension of ammonia) and gaseous (e.g., carbon dioxide) fertilizers.

Fertilizers are divided into water-soluble and soil-acid-soluble fertilizers, depending on the degree of melting. All nitrogen and potassium fertilizers are water-soluble fertilizers. Plants assimilate them quickly. However, they quickly dissolve in groundwater and wash away. Fertilizers soluble in soil acids include most phosphates. They slowly dissolve, but remain in the soil for a long time.

Fertilization not only increases the amount of nutrients absorbed by plants in the soil, but also affects its physicochemical and biological properties, increasing soil fertility. The acidity or alkalinity of the fertilizer applied affects the soil environment. For example, when fertilizers such as $(NH_4)_2SO_4$ and NH_4Cl are systematically added to the soil, it makes the soil reaction acidic. Because the plant absorbs cations, as a result, hydrogen ions increase instead (due to water in the soil) and free acids (hydrochloric and sulfuric acids) accumulate in the soil. The pH of the soil changes.

Conversely, when fertilizers such as $NaNO_3$ are added too much, OH- ions accumulate in the soil. The soil reaction remains alkaline.

Therefore, it is not enough to describe fertilizers only chemically. They must also differ in their physiological properties, i.e., the fact that cations and anions are not used equally. Depending on these characteristics, fertilizers are divided into physiologically acidic, physiologically alkaline and physiologically neutral fertilizers. The latter does not change the soil reaction.

Mineral fertilizers should not stick to each other and become stones when stored, should not absorb moisture, should be less hydroscopic, should have the property of scattering when applied to the soil. Therefore, solid fertilizers are produced in three types: powder (particle size less than 1 mm), crystalline (crystal size greater than 0.5 mm), granular - in the form of bubbles (bubble size greater than 1 mm).

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In the following years, it is necessary to adjust the rate of dissolution of plant-assimilated nutrients in the soil, i.e. to ensure that the nutrients are transferred to the soil in a balanced way over a long period. Much attention is paid to the problem of increasing the effectiveness of the impact. For example, since 1985, Russia has been producing a new type of concentrated fertilizer Rost-1. It consists of macro- and boron, zinc, molybdenum, copper trace elements in the ratio of nitrogen, phosphorus, potassium, magnesium (1:1:1:0.1). Stimul-1 is also in production. It is a chlorine-free complex fertilizer, which contains macro- and boron, copper, manganese, zinc, molybdenum, trace elements in the ratio of N, P, K, Mg (1:1:1:0.1).

Another promising high-concentration complex fertilizer in the future is triamide phosphoryl-phosphoricamide oxide. $PO(NH_2)_3$ (44,l% N_2, 74,06% P_2O_5) is also long-acting and slow-acting due to the hydrolysis of ammonium orthophosphate by diamido- and monoamidophosphates. Ensuring the slow transition of any water-soluble substance to the soil solution can be achieved by coating the surface of the fertilizer wrappers with high molecular weight substances. Fertilizer encapsulation works are giving good results. In this case, the grains of fertilizer, which are well soluble in water, are covered with slow-soluble fertilizer the rate of transition of the fertilizer to the soil solution varies depending on the thickness of the coating layer, porosity.

In recent years, the production of liquid complex fertilizers (LCF) brand N_2:P_2O_5:K_2O- 10:34:10 has developed rapidly. Long-term, slow-acting phosphate fertilizers - superphos, nitrogen fertilizers-ureoform or urea-formaldehyde fertilizer (UFF) to prevent the nutrients in the inner layer of the soil from being washed away by rain and irrigation water, as well as urea-formaldehyde compounds and ammophos-based polymer fertilizers will be produced on an industrial scale:

Ammonium polyphosphate - $(NH_4)nH_2PnO_3n+l$

Urea polyphosphate - $[CO(NH_4)_2HPO_3]$

Potassium polyphosphate - $(KPO_3)n$

Calcium polyphosphate - $Ca(PO_3)n$ and other phosphates are promising.

The quality of a fertilizer is largely determined by how much of its active ingredient is stored in a way that the plant can absorb. For example, N_2 in nitrogen fertilizers is determined by the amount of P_2O_5 in phosphorus fertilizers, and K_2O in potassium fertilizers.

Common fertilizers are grouped according to their composition (Table 2)

Basic mineral fertilizers

Fertilizer	**The main component**	**Nutrient content,%**
Phosphorus fertilizer, P_2O_5		
Phosphorite	$Ca_2(PO_4)_3 \cdot CaF_2$	16-35
Simple superphosphate	$Ca(H_2PO_4) \cdot H_2O + CaSO_4 + H_3PO_4$	14-21
Double superphosphate	$Ca(H_2PO_4) \cdot H_2O$	40-50
Pretsipitat	$Ca(HPO_4) \cdot 2H_2O$	27-46
Metallurgical slag (spectacle or marten)	$4CaO \cdot P_2O_5 \cdot 5CaO \cdot P_2O_3 \cdot SiO_2$	14-20
Nitrogen fertilizers, N		
Liquid synthetic ammonia	NH_3	82.3
Technical ammonia water	$NH_3 + H_2O$	16.5-20.5
Ammonium nitrate (ammonium nitrate)	NH_4NO_3	32-35
Urea	$CO(NH_2)_2$	46-46.5
Urea aldehyde fertilizers (long-acting)	$NH_2CONHCH_2$	33-42
Ammonium sulfate	$(NH_4)_2SO_4$	19.5-21
Potassium fertilizers, K_2O		
Potassium chloride K-40	KCl + NaCl	38-42

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Potassium chloride K-50	$KCl + NaCl$	48-52
Potassium chloride K-60	KCl	60
Potassium sulfate	K_2SO_4	46-52
Potassium sulfate and magnesium Sulfate	$K_2SO_4+MgSO_4$	26-30

Diversity of mineral fertilizers, the abundance of types of raw materials require the use of different methods of obtaining fertilizers. Nevertheless, all of these methods go through the same type, similar processes. Therefore, the two main methods are widely used.

1. Method of thermal or thermochemical treatment of a mineral or a charge mixture (a mixture intended for burning).

2. Method of separation of substance by chemical treatment, melting and crystallization.

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