Fertilizer

A **fertilizer** is any material of natural or synthetic origin (other than liming materials) that is applied to soil or to plant tissues to supply one or more plant nutrients essential to the growth of plants. Many sources of fertilizer exist, both natural and industrially produced.

Classification

- Fertilizers are classified in several ways. They are classified according to whether they provide a single nutrient (e.g., K, P, or N), in which case they are classified as "straight fertilizers."
- "Multinutrient fertilizers" (or "complex fertilizers") provide two or more nutrients, for example N and P. Fertilizers are also sometimes classified as inorganic versus organic. Inorganic fertilizers exclude carbon-containing materials except ureas.
- Organic fertilizers are usually (recycled) plant- or animal-derived matter.
- Inorganic are sometimes called synthetic fertilizers since various chemical treatments are required for their manufacture.

Single nutrient ("straight") fertilizers

The main nitrogen-based straight fertilizer is ammonia or its solutions. Ammonium nitrate (NH_4NO_3) is also widely used. Urea is another popular source of nitrogen, having the advantage that it is solid and non-explosive, unlike ammonia and ammonium nitrate, respectively. A few percent of the nitrogen fertilizer market (4% in 2007) has been met by calcium ammonium nitrate ($Ca(NO_3)_2 \cdot NH_4 \cdot 10H_2O$).

The main straight phosphate fertilizers are the superphosphates. "Single superphosphate" (SSP) consists of 14–18% P_2O_5, again in the form of $Ca(H_2PO_4)_2$, but also phosphogypsum ($CaSO_4 \cdot 2H_2O$). Triple superphosphate (TSP) typically consists of 44-48% of P_2O_5 and no gypsum. A mixture of single superphosphate and triple superphosphate is called double superphosphate. More than 90% of a typical superphosphate fertilizer is water-soluble.

The main potassium-based straight fertilizer is Muriate of Potash (MOP). Muriate of Potash consists of 95-99% KCl, and is typically available as 0-0-60 or 0-0-62 fertilizer.

Multinutrient fertilizers

These fertilizers are common. They consist of two or more nutrient components.

Binary (NP, NK, PK) fertilizers

Major two-component fertilizers provide both nitrogen and phosphorus to the plants. These are called NP fertilizers. The main NP fertilizers are monoammonium phosphate (MAP) and diammonium phosphate (DAP). The active ingredient in MAP is $NH_4H_2PO_4$. The active ingredient in DAP is $(NH_4)_2HPO_4$. About 85% of MAP and DAP fertilizers are soluble in water.

NPK fertilizers

NPK fertilizers are three-component fertilizers providing nitrogen, phosphorus, and potassium.

NPK rating is a rating system describing the amount of nitrogen, phosphorus, and potassium in a fertilizer. NPK ratings consist of three numbers separated by dashes (e.g., 10-10-10 or 16-4-8) describing the chemical content of fertilizers. The first number represents the percentage of

nitrogen in the product; the second number, P_2O_5; the third, K_2O. Fertilizers do not actually contain P_2O_5 or K_2O, but the system is a conventional shorthand for the amount of the phosphorus (P) or potassium (K) in a fertilizer. A 50-pound (23 kg) bag of fertilizer labeled 16-4-8 contains 8 lb (3.6 kg) of nitrogen (16% of the 50 pounds), an amount of phosphorus equivalent to that in 2 pounds of P_2O_5 (4% of 50 pounds), and 4 pounds of K_2O (8% of 50 pounds). Most fertilizers are labeled according to this N-P-K convention, although Australian convention, following an N-P-K-S system, adds a fourth number for sulfur, and uses elemental values for all values including P and K.

Micronutrients]

The main micronutrients are molybdenum, zinc, boron, and copper. These elements are provided as water-soluble salts. Iron presents special problems because it converts to insoluble (bio-unavailable) compounds at moderate soil pH and phosphate concentrations. For this reason, iron is often administered as a chelate complex, e.g., the EDTA derivative. The micronutrient needs depend on the plant and the environment. For example, sugar beets appear to require boron, and legumes require cobalt,[1] while environmental conditions such as heat or drought make boron less available for plants.[23]

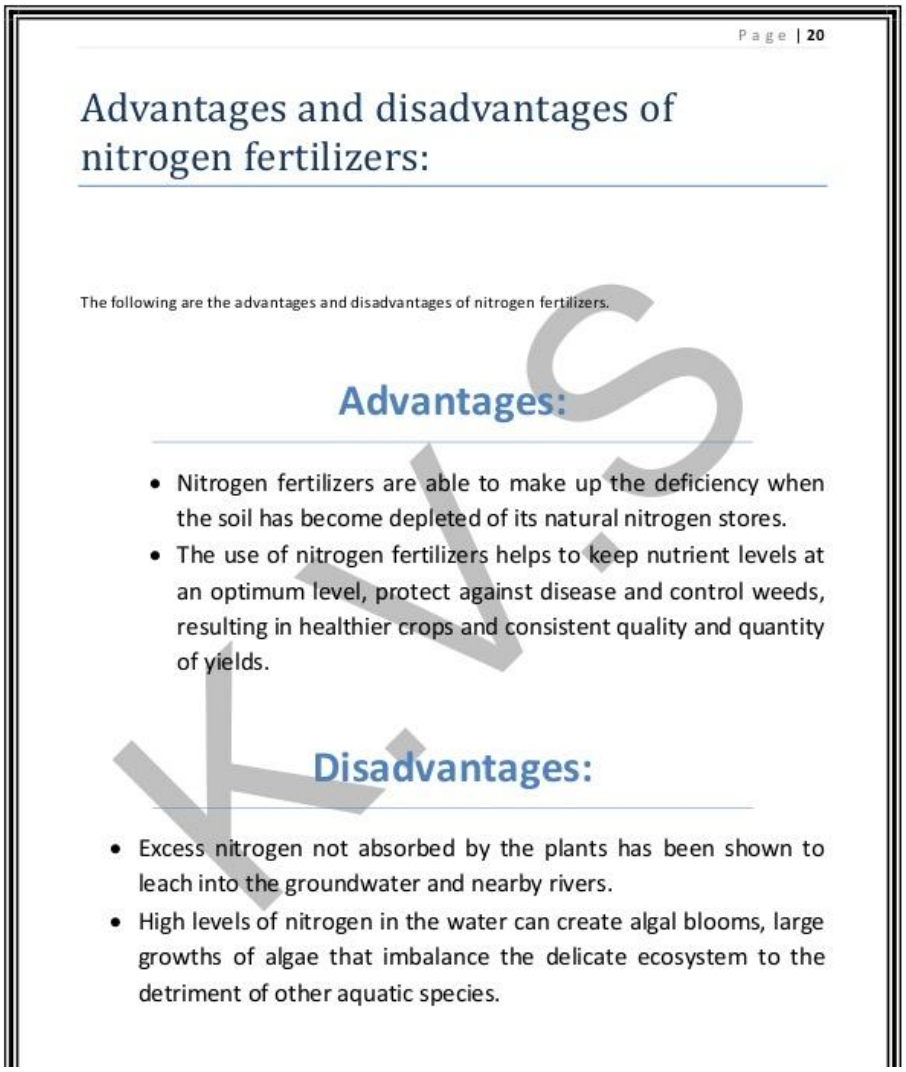
Nitrogen fertilizers

Nitrogen fertilizers are made from ammonia (NH_3), which is sometimes injected into the ground directly. The ammonia is produced by the Haber-Bosch process.[19] In this energy-intensive process, natural gas (CH_4) usually supplies the hydrogen, and the nitrogen (N_2) is derived from the air. This ammonia is used as a feedstock for all other nitrogen fertilizers, such as anhydrous ammonium nitrate (NH_4NO_3) and urea ($CO(NH_2)_2$).

Commercially uses N fertilizer Ammonium Nitrate N34.4

Composition: nitrogen (N) - 34.4 % (ammonia N (N-NH_4) - 17.2 %; nitrate N (N-NO_3) - 17.2 %).

Fertilizing effect: ammonium nitrate provides plants with required amount of nitrogen, which is especially important during the period of intensive growth. Fertilization not only ensures effective growth and ripening, faster root development, rapid nutrient absorption, but also prevents leave yellowing. Nitrogen stimulates and regulates many vital plant growth processes. Plants fertilized with ammonium nitrate consume less water, contain more proteins and sugar, have longer vegetation period.



Advantages and disadvantages of nitrogen fertilizers:

The following are the advantages and disadvantages of nitrogen fertilizers.

Advantages:

- Nitrogen fertilizers are able to make up the deficiency when the soil has become depleted of its natural nitrogen stores.
- The use of nitrogen fertilizers helps to keep nutrient levels at an optimum level, protect against disease and control weeds, resulting in healthier crops and consistent quality and quantity of yields.

Disadvantages:

- Excess nitrogen not absorbed by the plants has been shown to leach into the groundwater and nearby rivers.
- High levels of nitrogen in the water can create algal blooms, large growths of algae that imbalance the delicate ecosystem to the detriment of other aquatic species.

Phosphate fertilizers

All phosphate fertilizers are obtained by extraction from minerals containing the anion PO_4^{3-}. In rare cases, fields are treated with the crushed mineral, but most often more soluble salts are produced by chemical treatment of phosphate minerals. The most popular phosphate-containing minerals are referred to collectively as phosphate rock. The main minerals are fluorapatite $Ca_5(PO_4)_3F$ (CFA) and hydroxyapatite $Ca_5(PO_4)_3OH$. These minerals are converted to water-soluble phosphate salts by treatment with sulfuric (H_2SO_4) or phosphoric acids (H_3PO_4). The large production of sulfuric acid as an industrial chemical is primarily due to its use as cheap acid in processing phosphate rock into phosphate fertilizer. The global primary uses for both sulfur and phosphorus compounds relate to this basic process.

DAP is the world's most widely used phosphorus fertilizer. It is popular due to its relatively high nutrient content and its excellent physical properties. DAP is an excellent source of phosphorus (P) and nitrogen (N) for plant nutrition. It provides the correct proportion of phosphorous and nitrogen for the farming of grains such as wheat, barley, fruits, and vegetables. The global demand for DAP is about 30 million tons a year.

Potassium fertilizers

Potash is a mixture of potassium minerals used to make potassium (chemical symbol: K) fertilizers. Potash is soluble in water, so the main effort in producing this nutrient from the ore involves some purification steps; e.g., to remove sodium chloride (NaCl) (common salt). Sometimes potash is referred to as K_2O, as a matter of convenience to those describing the potassium content. In fact, potash fertilizers are usually potassium chloride, potassium sulfate, potassium carbonate, or potassium nitrate.

Placement of the fertilizer in a band approximately 3 inches to the side and 2 inches below the seed is an effective method of preventing fertilizer injury.

Compound fertilizers[(NPK)

Compound fertilizers, which contain N, P, and K, can often be produced by mixing straight fertilizers. In some cases, chemical reactions occur between the two or more components. For example, monoammonium and diammonium phosphates, which provide plants with both N and P, are produced by neutralizing phosphoric acid (from phosphate rock) and ammonia :

$$NH_3 + H_3PO_4 \rightarrow (NH_4)H_2PO_4$$
$$2\ NH_3 + H_3PO_4 \rightarrow (NH_4)_2HPO_4$$

Advantages:

100% water soluble

Reduces phosphate loss and increase yield

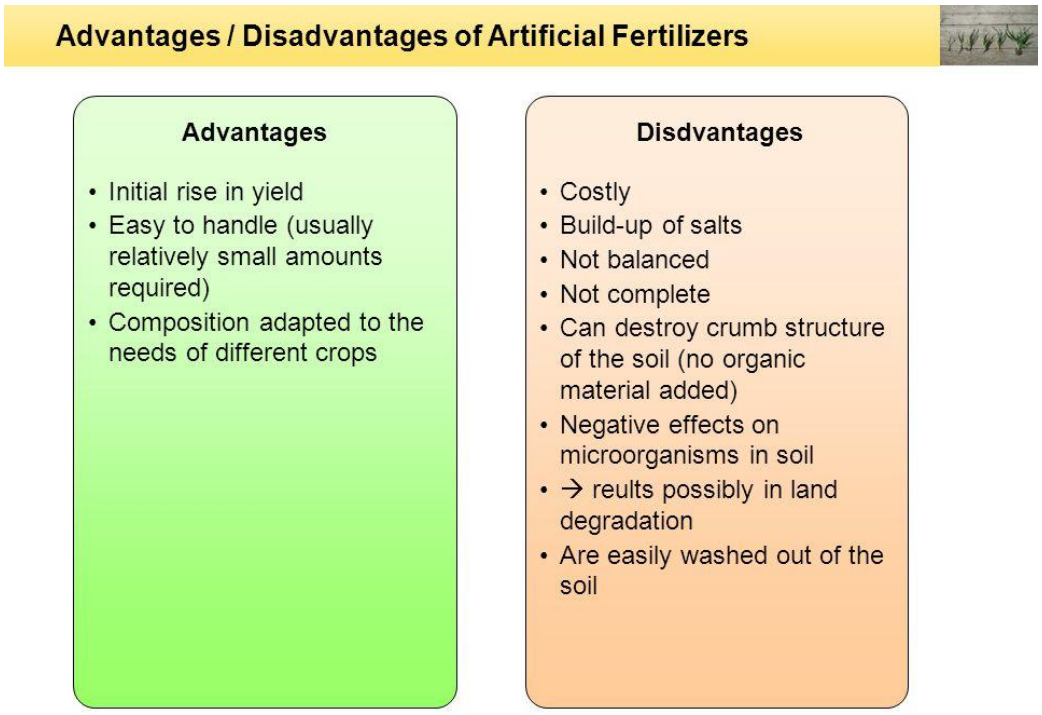
Ideal for all irrigation system, drip, tape, sprinkler and pivot systems

Organic fertilizers

"Organic fertilizers" can describe those fertilizers with an organic — biologic — origin—that is, fertilizers derived from living or formerly living materials. Organic fertilizers can also describe commercially available and frequently packaged products that strive to follow the expectations and restrictions adopted by "organic agriculture" and "environmentally friendly" gardening — related systems of food and plant production that significantly limit or strictly avoid the use of synthetic fertilizers and pesticides. The "organic fertilizer" *products* typically contain both some organic materials as well as acceptable additives such as nutritive rock powders, ground sea shells (crab, oyster, etc.), other prepared products such as seed meal or kelp, and cultivated microorganisms and derivatives.

Fertilizers of an organic origin (the first definition) include animal wastes, plant wastes from agriculture, compost, and treated sewage sludge (biosolids). Beyond manures, animal sources

can include products from the slaughter of animals — bloodmeal, bone meal, feather meal, hides, hoofs, and horns all are typical components.



Advantages and disadvantages of different types of fertilisers

The following tables provide an overview of the key advantages and disadvantages of different types of fertilisers on the market today [9] [13].

Nitrogen fertiliser

Type	% N	Advantages	Disadvantages
Urea	46	Cheap, easy to store	Loss through leaching and volatisation, acidifying
Ammonium nitrate (AN)	34	Little volatisation, non-acidifying	Expensive, difficult to store
Sulphate of ammonium (SA)	20.6	Easy to store	Expensive, very acidifying, induces Mg deficiency

Phosphate fertiliser

Type	% P_2O_5	Advantages	Disadvantages
Triple Super Phosphate (TSP)	45–47	Very soluble, effective, also contains 20% CaO	Expensive
Diammonium Phosphate (DAP)	46	Very soluble, also contains 18% N and 11% S	
Rock Phosphate (RP)	30–34	Inexpensive, effective, also contains 45% CaO	Bulky, slower response, high transport costs

Potassium fertiliser

Type	% K_2O	Advantages	Disadvantages
Muriate of Potash (MOP, KCl)	60	Relatively cheap, effective, also contains 35% Cl	
Bunch ash	20–40	Cheap, increased soil pH, effective	Cannot be stored for long, difficult to obtain for smallholders