



Sources of Plant Nutrition: Organic and Inorganic Fertilizers

(*Narendra Pratap Verma¹, Abhilash Singh¹, Virendra Pratap Verma², Ankit Singh¹ and S.K. Pande¹)

¹School of Agriculture Science, LNCT University Bhopal (M.P.)

²Narain College, Shikohabad, Firozabad (U.P.)

*Corresponding Author's email: narendra10230@gmail.com

A fertilizer is any material of natural or synthetic origin that is applied to soils or to plant tissues to supply one or more plant nutrients essential to the growth of plants.

Crops grow in a very thin layer of the Earth's crust, so it is important to maintain the nutrient level by the addition of both organic (plant and animal residues) and inorganic (manufactured mineral fertilizers) sources. It is important to note that when supplied to plants in the organic form, nutrients still must cycle through the inorganic form before becoming available to plants. **David W. Dibb (2002)**

Fertilizers can be categorized into 2 groups *i.e.*, Organic and inorganic fertilizers.

1. Organic fertilizers

“Organic fertilizers” can describe those fertilizers with a biological origin *i.e.*, derived from living materials. Organic fertilizers are environmentally friendly in nature. The “organic fertilizer” products typically contain both organic as well as acceptable additives. Naturally occurring organic fertilizers include animal wastes from meat processing, peat, manure, slurry, and guano.

Types of Organic Fertilizers

Manure: Manure for the garden comes from cow, sheep, poultry and horses. Pretty self-explanatory. Manure is known as a “complete” fertilizer; it has a lot of organic matter but is low in nutrients. Manures are most valuable as organic soil amendments and mulches.

Blood Meal: Derived from slaughterhouse waste (generally cattle), dried powdered blood contains approximately 12% N and rapidly mineralizes to plant-available forms. It is completely soluble and suitable for distribution through irrigation systems. Robert Mikkelsen and T.K. Hartz, 2008.

Bone meal: Bone meal is finely ground bone. A by-product from animal slaughterhouses, it is a great source of calcium and contains up to 15% phosphate. Bone meal promotes strong root systems and flowering. It is often used when growing flowers, bulbs, and fruit trees.

Bat guano: Bat guano is protected by caves from leaching, so nutrients are conserved. It is rich in soluble nitrogen, phosphorous and trace elements. Usually powdery, bat guano may be used any time of year as a top dressing or diluted in a tea and used as a foliar spray.

Shellfish fertilizer: Shellfish fertilizer or shell meal is made from crushed bones or shells from crab or other shellfish. It is a great source of calcium in addition to phosphorus and many trace minerals. It contains chitin, which encourages the growth of organisms that inhibit harmful pest nematodes.

Rock phosphate: Rock phosphate is a calcium or lime-based phosphate rock that is usually ground to the consistency of small crumbs. This rock powder contains over 30% phosphate

and many traces elements. Rock phosphate does not leach out of the soil, remaining unchanged until taken up by the roots.

Greensand: Greensand is an iron potassium silicate that gives the minerals in which it occurs a green tint. Mined from an ancient New Jersey seabed deposit of shells, Greensand is rich in iron, potassium, and numerous micronutrients.

Fish emulsion: Fish emulsion is a partially decomposed blend of finely pulverized fish. It can smell, although some deodorized versions have been developed. Like blood meal, it should be used sparingly in order not to burn plant roots.

Advantages of using organic fertilizers

1. Soil Structure: Because of the organic matter present in fertilizer, soil structure is improved and as a result the soil's ability to hold water and nutrients increases.

2. Microbes Thrive: Organic fertilizer is rich in organic matter, which helps microbes thrive. Organic fertilizer contains carbon as part of its chemical makeup and it is the carbon, along with nitrogen, phosphorus and potassium that feeds microbes and enables them to make nutrients available for plants in a naturally occurring biological process.

3. Sustainable and Environmentally Friendly: Organic fertilizers do not run off as easily and are associated with soil structure. organic fertilizer also increases species biodiversity by 30% compared with synthetic fertilizer (Organic Trade Association).

4. Reduce Fertilizers and Pesticides: Although organic fertilizer can be more costly than synthetic, it can reduce the need for pesticides and the overall nitrogen, phosphorus and potassium requirements. Because of the reductions, organic fertilizer can be cost neutral and sometimes a cost savings.

Disadvantages of using organic fertilizers

1. Not All Products Are Created Equally
2. Nutrient Levels Are Low
3. Compost is a Complicated Procedure

Inorganic Fertilizers

Inorganic fertilizers also referred to as synthetic fertilizers *i.e.*, manufactured artificially and contain minerals or synthetic chemicals. For example, synthetic nitrogen fertilizers are typically made from petroleum or natural gas. They come in different forms like dry, liquid, slow-release and soluble solutions. Inorganic fertilizers provide plant nutrients in a readymade form and release the nutrients quickly so that the plants are able to get the nutrients as soon as possible. Inorganic fertilizers have the necessary amounts of the three main nutrients that the plants require to help them to survive. Inorganic fertilizers tend to leach; excessive use can lead to a buildup of salts in the soil, which cause damage to the plant. Nitrogen is very vulnerable to leaching. Chemical fertilizers do not build up the soil and long-term use of the same will deplete the soil of valuable microbes.

Types of inorganic fertilizers

Complete vs. Balanced: Inorganic fertilizers come in single-nutrient or multinutrient formulas. Multinutrient formulas include complete and balanced fertilizers, which contain basic nutrients such as nitrogen, phosphorus and potassium, as well as secondary and micronutrients such as calcium, magnesium, boron and manganese. The percentage of nitrogen, phosphorus and potassium contained in both complete and balanced fertilizers is indicated by three numbers on the package. For example, a 5-10-5 formula is a complete fertilizer, containing 5 percent nitrogen, 10 percent phosphorus and 5 percent potassium. Balanced fertilizers are those that contain equal nutrient amounts, such as a 10-10-10 formula.

Slow-Release and Specially Formulated: Other types of inorganic fertilizers include slow-release formulas. These formulas contain larger molecules that are coated, helping them to break down slowly in the soil. A typical slow-release fertilizer releases nutrients over a period of 50 days to a year, reducing the chance of burning the plant or root system. Specially formulated inorganic fertilizers are those that are created for a specific type of plant. Specially formulated fertilizers are usually highly acidic and should be used only on the plants for which they are indicated.

Organic Fertilizers vs. Inorganic Fertilizers: There are advantages and disadvantages to organic and inorganic fertilizers. The major benefit of organic fertilizers is that they work slowly. They need to be broken down by soil organisms in order for their nutrients to be released and that takes time. Because they work slowly, nothing is wasted. They are consumed as they are released, unlike inorganic fertilizers, which are released immediately into the soil. Organic fertilizers contain organic materials. They improve the soil's structure or its workability, makes soil more arable increases waer holding capacity of soil and increases the bacterial and fungal activity in the soil. Organic fertilizers are slowly released into the soil; they are not immediately available to plants.

The primary nutrients supplied by fertilizers are nitrogen, phosphorus and potassium. Their concentration in a fertilizer is expressed as percentage of N, P₂O₅ and K₂O. According to nutrient content of fertilizers, it can be classified as straight and complex fertilizer. Straight fertilizer contain only one plant nutrient where as complex fertilizer contain more than one primary or major nutrient element.

Straight fertilizer

Nitrogen: Nitrogen is the first fertilizer element of the macronutrients usually applied in commercial fertilizers. Nitrogen is very important nutrient for plants and it seems to have the quickest and most pronounced effect. In the case of nitrogenous fertilizers, nitrogen may be in the ammoniacal, nitrate or amide form.

Nitrogenous fertilizer - Source of Nitrogen

| Name of fertilizers | Percentage of Nitrogen |
|--------------------------------|------------------------|
| Ammonium Sulphate | 20.6-21.0 |
| Urea | 44.0-46.0 |
| Ammonium Chloride | 25 |
| Ammonium Nitrate | 32-35 |
| Ammonium Sulphate Nitrate | 2.6 |
| Calcium Ammonium Nitrate (CAN) | 25.0 |
| Sodium Nitrate | 16.0 |
| Calcium Nitrate | 15.6-21.6 |
| Potassium Nitrate | 13.0 |
| Calcium cyanamide | 212.0 |

Phosphorus: Phosphorus is the second fertilizer element and it is an essential constituent of every living cells and for the nutrition of plant and animal. It takes active part in all types of metabolism of plant. Phosphate present in phosphatic fertilizers may be in the water soluble form or citrate soluble form.

Phosphatic fertilizer – Source of phosphorous

| Name of fertilizers | Percentage of P ₂ O ₅ |
|-----------------------|---|
| Single Superphosphate | 16.1 -20.0 |
| Double Superphosphate | 30.1 -35.0 |
| Triple Superphosphate | 45.0 -50.0 |
| Basic Slage (India) | 3.00 -8.00 |

| | |
|---------------------|------------|
| Dicalcium Phosphate | 35.0 -40.0 |
| Rock Phosphate | 20.0 -25.0 |

Potassium: Potassium is the third fertilizer element. Potassium acts as a chemical traffic policeman, stalk strengthener, food former, sugar and starch transporter, protein builder, breathing regulator, water stretcher and as a disease retarder but it is not effective without its co-nutrients such as nitrogen and phosphorus.

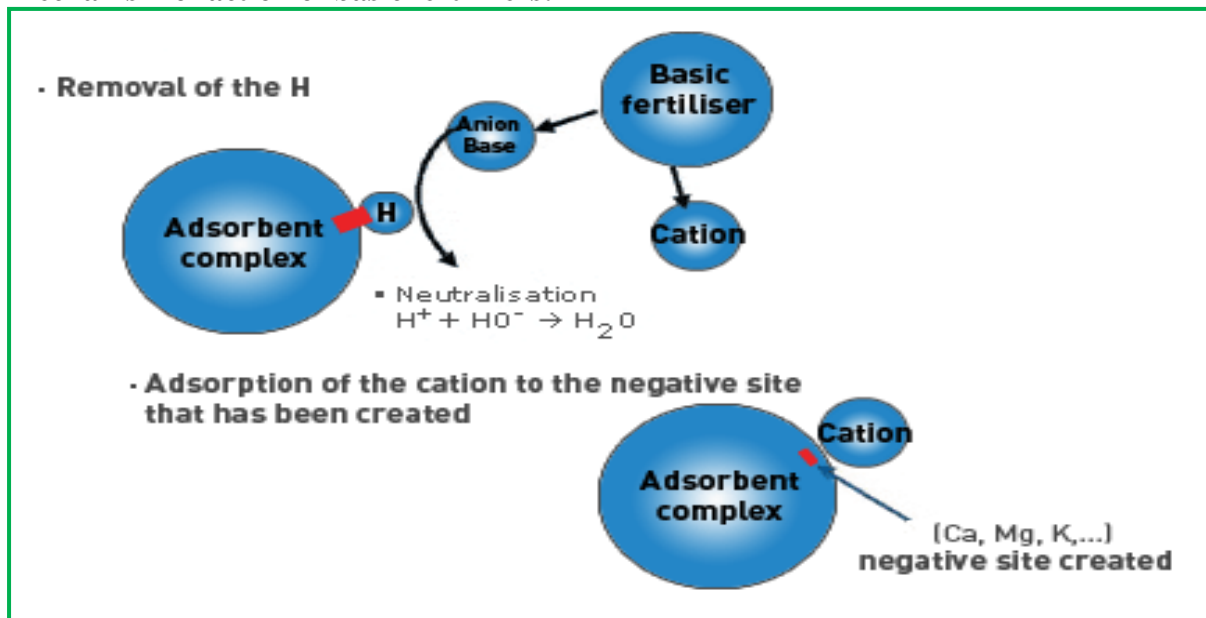
Potassic fertilizer – Source of potassium

| Name of fertilizers | Percentage of |
|---------------------|---------------|
| Murate of potash | 50.0-60.0 |
| Potassium sulphate | 48.0-52.0 |

Complex fertilizers:

Complex NPK fertilizers have the advantage of having each nutrient in each granule. They are more expensive than the equivalent quantity of nutrients achieved by applying the equivalent quantities of straight fertilizers.

Mechanism of action of basic fertilizers:



Conclusion

Applying a basic inorganic fertiliser increases the surface electrical charges of organic matter and clays (increase in the effective CEC). We already know that this gives rise to an improvement in the soil's physical, chemical, and biological properties. We have shown here that the degree of alkalinity is linked to the type of dressing and determines its ability to change the effective CEC.

References

1. Organic Fertilizers: Types, Production and Environmental Impact, (2012) *Nova Science Inc*, Isbn: 978-1-62081-422-2., New York.
2. David W. Dibb(2002), Introduction to Inorganic and Organic Nutrients, *Better Crops*, Vol. **86**(2) page 3.
3. Robert Mikkelsen and T.K. Hartz (2008), Nitrogen Sources for Organic Crop Production, *Better Crops*, Vol. **92** (4) page 16-19.
4. *Casandra Maier (2018) Types of inorganic fertilizers.*