

Organic and inorganic fertilizers

What is a fertilizer?

A fertilizer is any material, organic or inorganic, natural or synthetic, that supplies plants with the necessary nutrients for plant growth and optimum yield. Organic fertilizers are natural materials of either plant or animal origin, including livestock manure, green manures, crop residues, household waste, compost, and woodland litter. Inorganic (or mineral) fertilizers are fertilizers mined from mineral deposits with little processing (e.g., lime, potash, or phosphate rock), or industrially manufactured through chemical processes (e.g., urea). Inorganic fertilizers vary in appearance depending on the process of manufacture. The particles can be of many different sizes and shapes (crystals, pellets, granules, or dust) and the fertilizer grades can include straight fertilizers (containing one nutrient element only), compound fertilizers (containing two or more nutrients usually combined in a homogeneous mixture by chemical interaction) and fertilizer blends (formed by physically blending mineral fertilizers to obtain desired nutrient ratios).

Specific properties of organic fertilizers

Organic nutrient sources are highly heterogeneous and vary in quality and quantity. The quality aspect is important in determining the nutrient release potential of the organic fertilizer. Microorganisms that decompose organic fertilizers use the carbon in such materials as an energy source for growth. Required in even bigger quantities by microorganisms for growth and reproduction is nitrogen (N). Commonly available materials are often particularly low in N content. For organic fertilizers with low N contents (such as cereal straw and most smallholder farmyard manures), microorganisms themselves will consume much of the available N for their own growth. Consequently, insignificant amounts of N will be released for the crop. Thus, on their own,

poor quality materials have limited potential to enhance productivity. The effectiveness of such materials can be improved by combining them with mineral N fertilizers such as ammonium-nitrate or urea. Mineral fertilizers may be used more efficiently by crops growing on soils with adequate amounts of soil organic matter supplied by organic fertilizers.

What are the differences between organic and inorganic fertilizers in terms of their use?

Organic fertilizers: Soil fertility on smallholder farms is almost entirely dependant on locally available resources. Cattle manure, cereal and legume stover, and woodland litter are the commonly used organic fertilizers, but these are rarely applied in sufficient quantities to impact on crop yields. The use of high quality organic fertilizers is rarely practised, although through research and extension activities in Africa, some farmers now include legume green manures or legume-based fallows in crop sequences. The main advantage of using organic fertilizers is that, compared to mineral fertilizers, they are usually available on or near the farm at very little or no cost other than labor costs of handling, transportation, or opportunity costs of land used for their production.

Inorganic (mineral) fertilizers:

Mineral fertilizers need to be applied to crop at least two times within a growing season (split application), either basally at planting or top-dressed during vegetative growth. The amount of inorganic fertilizer used in most smallholder farming systems falls far below standard extension recommendations, due to poor purchasing power, risk aversion due to poor and unreliable rainfall, and lack of significant returns. When available, fertilizer use is not overly labor intensive, thus allowing time for other tasks (or for earning income elsewhere).

What are the differences between organic and inorganic fertilizers in terms of application?

The method and timing of fertilizer application is an essential component of good farming. For organic materials, decomposition rate and timing of application influence the release of nutrients to the crop. Organic fertilizer application methods include broadcasting, banding, and spot application (or side-dressing). Broadcasting requires less labor and helps to evenly cover the field surface before incorporation into soil through plowing or hand-hoeing. Incorporation generally increases the fertility status of the whole plow layer. If the quantity of organic fertilizer is limited, it may be banded along furrows or spot applied, but the seed needs to be placed away from the fertilizer. Side-dressed organic fertilizers are not likely to have much immediate effect due to delayed nutrient release.

Mineral fertilizers can be applied by hand or with application equipment. When hand applied, it is essential to distribute the fertilizers uniformly and at the recommended rates to avoid over- or under-fertilization. Application equipment needs proper adjustment to ensure uniform spreading. Broadcast fertilizer should be incorporated after application to enhance effectiveness or to avoid evaporation losses of N. With banding or spot application, take care that no fertilizer is placed too close to either the seed or the germinating plant, to avoid damage to the seedling or roots.

What are the differences in terms of their effectiveness?

Continued use of organic fertilizers results in increased soil organic matter, reduced erosion, better water infiltration and aeration, higher soil biological activity as the materials decompose in soil, and increased yields after the year of application (residual effects). Proper handling of

organic fertilizers enhances their quality and effectiveness. For example, with the exception of green manures, there is significant crop response if organic fertilizers are combined with N-based mineral fertilizers or other N-rich organic materials. Mineral fertilizers on the other hand immediately supply nutrients needed by crops. Basal fertilizers contain elements required for good crop establishment and early growth while top-dressing can be done through split applications depending on visible hunger signs and/or moisture availability. In risky environments, spot application of small amounts of N fertilizers improves fertilizer effectiveness. The best response to fertilizer use is obtained if the soil has a high inherent fertility level (high organic matter status). Building inherent fertility requires practices such as retaining crop residues on the field.

Major limitations of organic and inorganic fertilizers

Organic fertilizers

- Generally require large amounts to have desired effects
- Extra investment in labor for harvesting (green manures) and preparation (cattle manure)
- Unavailability of seed for green manures is one of the major limitations
- Quality for most has to be enhanced by combining with expensive mineral fertilizers
- Green manures must occupy land at a time when other food crops could be grown.

Mineral/ inorganic fertilizers

- Require high purchasing power
- Availability is an obstacle, especially in remote areas
- Need to be applied seasonally
- High risk in low rainfall and very high rainfall areas