

Organic fertilizers

for sustainable nutrient management

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Organic fertilizers are naturally available mineral sources that contain moderate amount of plant essential nutrients. They are capable of mitigating problems associated with synthetic fertilizers and reduce the necessity of repeated application of synthetic fertilizers to maintain soil fertility. Organic fertilizers are safer than chemical fertilizers, as they improve the soil physical, chemical and biological properties along with soil carbon sequestration. Their slow-release nutrient system provides stable nutrition to plants throughout periods of vegetative, flowering and ripening growth. This controlled release of organic fertilizers is eco-friendly, effective and an advanced way to maintain sustainable agriculture productivity.

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ORGANIC fertilizers play an important role in minimizing environmental damage without reducing crop yields and help to achieve sustainable levels of agriculture production. They can be natural or processed, such as compost, blood meal and humic acid, natural enzyme-digested proteins, fish meal and feather meal. Organic fertilizers act as slow-release fertilizers, as they provide nutrients in lower amounts during crop cycle. They mitigate the risk of eutrophication, ground water contamination, over fertilization and, also improve soil (microbiological, physicochemical and biochemical) properties and thus, influence health and productivity. Organic fertilizers enhance the existing soil nutrients, and thereby healthy growth is achieved with minimum nutrient densities.

Natural organic fertilizers

Organic manure: Organic manures are mostly derived from animal excretion (except in the case of green manure). They are the main sources of organic fertilizers

in agriculture. Manures boost the fertility of the soil by adding nutrients such as nitrogen that can be utilized by microorganisms in the soil.

Cattle manure: Cow dung, also known as cow manure is the excretory waste of bovines; like domestic cattle, buffalo. Cow dung is the undigested residue of plant matter which has passed through the animal's gut. A well decomposed dung contains 0.5% N, 0.2% P and 0.5% K. They are mixed into the soil or used as top-dressing for plants and vegetables as a nutrient-rich fertilizer. They are commonly used as starting inputs as they mineralize slowly.

Peanut hulls manure: Peanut shells are a wonderful source of N, P and K as they contain 1.2% nitrogen and the levels of potassium and phosphorus are lower at 0.8% and 0.5%, respectively. They are mainly used for the manufacturing of livestock feed and are also known to improve productivity in terms of yield and thought to increase soil fertility as well.

Poultry manure: Poultry litter

is one of the best organic fertilizers available and is an extremely valuable resource. The average nutrient content is 3.3% N, 2.63% P and 1.4% K. It improves soil fertility and enhances the development of the roots system, the vigour of the plants and makes them less susceptible to diseases and pest attacks. Poultry manure mineralizes fast in soil and produces a lot of heat; hence, it is not advisable to use it during warm seasons.

Fish manure: Dried and ground fish is a valuable fertilizer and has a broad range of application compared to the other manure types. The nutrients containing range is 4–10% N, 3–9% P and 0.3–1.5% K. It improves plant resistance to pests such as bollworms and nematodes, and the quality of the fruits (coloration and rate of dry matter). Fish manure is suitable for crops like lettuce and onion.

Horse dung manure: Horse manure is a good source of nutrients and a popular additive to many home gardens. Every 1000 kg of bedded horse manure contains about 6 kg of total N, 2.5 kg of P_2O_5 ,

and 4.5 kg of K_2O . Horse manure also contains large amounts of carbon, organic matter and many valuable minor plant nutrients, such as Ca, Mg, S, Zn, Cu, Mn and Fe. Horse dung manure is highly valued by farmers because composting of horse manure makes the compost pile become super charged and also increases soil fertility, regeneration and high quality yields.

Processed organic fertilizers

Bone meal: Bone meal decomposes slowly and releases phosphorus gradually. In the case of water-soluble inorganic fertilizer, they quickly partition into soil water increasing the salt concentration and imposing an osmotic potential. Hence, the best strategy that can be used to avoid microbial inhibition is the use of controlled-release fertilizers. Nitrogen mineralization from cod bone meal is greater at 20°C, pH 6.5 and 7.5. Animal by-products are rich in nutrients and energy. Meat bone meal contains considerable amounts of nutrients like 1–2% N, 25–30% P and can be used as a potential organic fertilizer for agricultural crops.

Cotton seed meal: Cotton seed meal is the by-product of oil extraction from cotton seeds and mainly used for acid-loving plants such as rhododendrons, blueberries and azaleas. Naturally obtained cotton seed meal fertilizers

are applied prior to planting for treating high soil pH to replace depleted trace elements in the soil. This fertilizer has an N:K ratio of 6:4.

Blood meal: Blood meal is one of the main fertilizers allowed to be used in organic farming. Dried blood from cattle slaughterhouses can be used as organic N fertilizer because it contains about 10–13% organic N. The main component of the fertilizer is hemoglobin, which is characterized by the presence of a prosthetic group containing iron. The blood needs to be dried before being used as blood meal and is spread on gardens to deter pest animals such as rabbits. These animals smell the blood and are repelled by the odour.

Sea weed: It is a broad spectrum fertilizer that is rich in beneficial trace metals and hormones that stimulate plant growth. Seaweed is low in cellulose, so it breaks down quickly and is rich in carbohydrates which are essential building blocks in growing plants. The main benefit of using seaweed fertilizer is that it does not produce any unpleasant odor as that of fish emulsion but is more costly. It is either applied to the soil as mulch or can be added to the compost heap, where it is an excellent activator.

Wood ash: Wood ash from bonfire is known to be a potential source of potash and lime for agriculture use since many years. Generally,

wood ash contains less than 10% potash, 1% phosphate and trace amounts of micro-nutrients such as iron, manganese, boron, copper and zinc. Wood ash fertilizer is best used when lightly scattered, being composted along with other organic matter. Depending on the type of wood, the nutrient composition of wood ash varies. Ashes made from burning hard woods like oak and maple have high nutrients and minerals compared to soft wood. The salt in the wood ash is used as pest control to kill bothersome pests like snails, slugs, and some kinds of soft-bodied invertebrates, by simply sprinkling it around the base of the plants.

Controlled release of organic fertilizers

Granulated fertilizers that release nutrients gradually into the soil are called controlled-release fertilizers. Controlled-release particulate fertilizers are formulated with the aim of constant supply of three nutrients (N, P and K) that form the primary nutrient sources. N should be released slowly and steadily to meet the growth needs of the plant. On the other hand, K and P do not disperse readily in most soils and they are generally desired to be released quickly. Controlled released fertilizers are not water soluble and their nutrients disperse into soil more slowly compared to conventional fertilizers that are soluble in water, whose nutrients are easily dispersed as the fertilizer dissolves.

Glass matrix fertilizer: A glass matrix fertilizer is a product from ceramic industries which has the ability to release nutrients on the basis of plant demand but only in the presence of metal complexing solutions, a process similar to those exuded by plant roots. This ensures a stable release of nutrients over time, limiting the risk of their loss in the environment. As a procedure to improve fertilizer performance, glass matrix fertilizer was mixed with different organic biomasses, such as leather meal, digested vine vinasse, pastazzo (a by-product of the citrus processing industry) or green compost. Organic biomasses



Vocational training organized on organic farming at KVK campus



Field visit of farmers at Januti village under organic farming training

mixed with glass matrix fertilizer increased the release of macro and micronutrients through an activation effect, which suggests the application of these organo-mineral fertilizers for sustainable crops production.

Organo mineral fertilizer: Nutrient imbalance in agriculture resources can be overcome with the use of bio-solids, a waste material commonly known as sewage sludge. Sewage sludge is generally rich in phosphorous but low in potassium and nitrogen. Mineral composition of sewage sludge can be enriched with the addition of urea and muriate of potash as sources of K and N. The nutrient balanced sludge-based organo mineral fertilizer is produced by baking digested sewage sludge cake at 80°C in a tumbling evaporator. The sludge granules thus produced are 3–6 mm in diameter.

Macromolecular slow-release fertilizer: The technology of macromolecular slow-release fertilizer containing N, P and K plays an important role in improving fertilizer use efficiency by plants

and also reduces the frequency of fertilization, thereby mitigating environmental pollution and leading to the development of sustainable agriculture. The structural analysis was characterized by the FTIR spectrum and the gel permeation chromatography showing the average molecular weight of the fertilizer to be 13,500. Moreover, the effect of the decomposition of the macromolecular fertilizer in soil and water is environmentally safe.

Liquid organic fertilizers

Foliar feeding can supply nutrients when they are lacking or unavailable in the soil, or when roots are stressed. Some foliar fertilizers, such as liquid seaweed, are rich in micronutrients and growth hormones. Compost tea and seaweed extract are two common examples of organic foliar fertilizers. With flowering and fruiting plants, foliar sprays are most useful during critical periods (such as after transplanting or during fruit set) or periods of drought or extreme temperatures.

Future perspectives

Sustainable consumption patterns that meet human needs, improve the quality of lives, and reduce pollutants in the product life cycle are urgently needed. Chemical fertilizers and pesticides are a source of contaminants that are damaging ecosystems. Therefore, it is assumed that the sustainable utilization of organic fertilizers would provide essential elements for soil and therefore, their use as an alternative to chemical fertilizers could help mitigate the impacts that are responsible for soil and water contamination.

SUMMARY

Organic fertilizers that are free or substantially free from toxic chemicals or metals can be used as a component of fertilizers. Organic fertilizer increases the organic composition of the soil along with the plant nutrients. The slower nutrient release improves overall physical characteristics of the soil, thus improving sustained availability of the nutrients, soil aeration, and prevents root burn and leaching losses compared to inorganic fertilizers. Organic fertilizers act as an energy source for microorganisms in the soil, thereby improving soil structure and plant growth. Organic fertilizers provide a long-term protection to agriculture from harmful effects of inorganic fertilizers, which lead to soil damage and pollution.

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