

Detrimental effects of Chemical fertilizer's on soil fertility

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Introduction:

For life to thrive and survive, soil is a crucial resource. It offers several ecological functions, including promoting plant development, controlling the flow of water and nutrients, and preserving biodiversity. The biological, chemical, and physical characteristics of the soil influence its health. However, a number of problems, including salinization, deterioration, erosive forces, and pollution, pose a danger to the health of the soil. The excessive and incorrect application of chemical fertilizers is one of the main causes of soil deterioration. Chemical fertilizers are man-made compounds added to the soil to provide nutrients for plants. They mostly include nitrogen, phosphorus, and potassium, three macronutrients vital to plant development. For contemporary agriculture to improve crop output and quality, chemical fertilizers have been employed extensively. On the other hand, they also negatively affect the ecology and soil fertility.

Impact on the physical characteristics of soil:

Chemical fertilizers can affect the

physical characteristics of soil, such as:

Soil structure: how the soil particles are arranged into aggregates or crumbs

Soil texture: the proportional distribution of sand, silt, and clay particles in the soil

Soil porosity: the amount of pore space or air gaps in the soil

Soil water-holding capacity: the ability of the soil to retain water for plant use

Soil infiltration rate: the speed at which water enters and moves through the soil.

Chemical fertilizers can damage the soil structure by eroding the organic materials and minerals that bind the soil particles together. Chemical fertilizers can change the soil texture by making it more acidic and saline. Chemical fertilizers can reduce the soil porosity and water mobility by causing compaction, crusting, and hardening of the soil surface. Chemical fertilizers can harm the microorganisms and plants in the soil by increasing the salt concentration and releasing toxic elements like manganese and aluminum.

Impact on the Chemical characteristics of soil:

➔ Chemical fertilizers can affect the soil

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chemical properties, such as:

- Soil pH: a measure of the acidity or alkalinity of the soil
 - Soil organic matter (SOM): the fraction of the soil that consists of plant and animal residues and their decomposition products
 - Nutrient balance: the optimal ratio of nutrients in the soil for plant growth
 - Cation exchange capacity (CEC): a measure of the ability of the soil to retain positively charged ions (cations) such as calcium, magnesium, potassium, sodium, ammonium, hydrogen, etc.
- ➔ Chemical fertilizers can lower the soil pH by releasing hydrogen ions or nitrates into the soil
- Low pH can reduce the availability of phosphorus and micronutrients such as iron, zinc, copper, and manganese
 - Low pH can also inhibit the growth of beneficial bacteria and fungi that decompose organic matter and fix nitrogen
- ➔ Chemical fertilizers can decrease the SOM content by stimulating microbial respiration and mineralization
- This can result in a loss of carbon dioxide and nutrients from the soil
- ➔ Chemical fertilizers can disrupt the nutrient balance by supplying excessive or imbalanced amounts of nutrients to the soil
- Excessive nutrients can cause leaching, runoff, volatilization, or immobilization losses from the soil
 - These losses can pollute the air, water, and soil with greenhouse gases (such as nitrous oxide), eutrophication agents (such as nitrates and phosphates), or toxic substances (such as ammonia)
 - Imbalanced nutrients can cause antagonism or synergism effects among nutrients in the soil
 - These effects can reduce or enhance the availability or uptake of certain nutrients by plants
- ➔ Chemical fertilizers can reduce the CEC by displacing the native cations with the added cations from the fertilizers
- This can result in a loss of base cations (such as calcium and magnesium) from the soil
 - This can also increase the acidity and salinity of the soil

Impact on the Biological characteristics of Soil:

- ➔ Chemical fertilizers can affect the soil biological properties, such as:
- Microbial biomass: the total amount of living microorganisms in the soil

- Microbial diversity: the number and variety of microbial species in the soil
- Microbial activity: the rate and extent of microbial processes in the soil
- ➔ Microorganisms play a crucial role in the soil fertility and quality. They perform various functions, such as:
 - Decomposing organic matter and recycling nutrients
 - Fixing nitrogen and solubilizing phosphorus
 - Producing enzymes and hormones that stimulate plant growth
 - Suppressing plant pathogens and pests
 - Participating in biogeochemical cycles and regulating greenhouse gas emissions
- ➔ Chemical fertilizers can affect the soil microbial properties by changing the soil environment and nutrient availability. They can have negative impacts, such as:
 - Reducing the microbial biomass by increasing the salt content and acidity of the soil
 - Reducing the microbial diversity by selecting for certain microbial groups that can tolerate or utilize the added nutrients
 - Altering the microbial activity by stimulating or inhibiting certain microbial processes in the soil

Conclusion:

Chemical fertilizers have been widely used in modern agriculture to increase crop yield and quality. However, they also have negative impacts on the soil fertility and the environment. Chemical fertilizers can affect the soil physical, chemical, and biological properties by destroying soil structure, altering soil texture, lowering soil pH, decreasing soil organic matter, disrupting nutrient balance, reducing cation exchange capacity, affecting microbial biomass, diversity, and activity, and polluting the air, water, and soil with harmful substances. Therefore, it is important to use chemical fertilizers judiciously and in conjunction with organic fertilizers and other sustainable practices to maintain and improve the soil health and quality.