

The Influence of Fertilizer on Soil Strength

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Introduction

Any substance, whether natural or synthetic, organic or inorganic, that delivers single or more chemical components needed for plant growth is considered a fertilizer. Most commonly used fertilizers in agriculture contain the three main plant nutrients: potassium, phosphorus, and nitrogen. Few fertilizers also encompass certain micronutrients such as zinc and other nutrients, which are needed for plant growth. Fertilizers are introduced to the soil to restore the essential minerals needed for plant growth. Soil physicochemical and biological characteristics control the health of the soil. Fertilizers are essential to modern agriculture. Agriculture will inevitably face these threats. They remain, nevertheless, essential instruments for global food safety. The problematic effects of artificial fertilizers cannot be disregarded when supportable cultivation is the worldwide goal. Chemical fertilizer is crucial for increasing soil fertility and crop output. In addition to raising

crop yields, fertilizer use modifies the physicochemical and biological characteristics of soil. Nonetheless, the ongoing use of chemical fertilizers is to blame for the reduction in soil organic matter content and a subsequent deterioration in agricultural soil quality. Overuse of chemical fertilizers causes environmental dangers by hardening the soil, decreasing soil fertility, polluting the air, water, and soil, and reducing vital soil and mineral nutrients. Weak microbial activity in the agricultural system resulted from the exclusive use of chemical fertilizers. Nonstop use of chemical fertilizers can alter the pH of the soil, rise pests, cause acidification and soil crust, and reduce the amount of organic matter, humus, and beneficial organisms in the soil. It can also hinder plant development and donate to greenhouse gas emanations. Due to their long-term durability, these will surely affect soil biodiversity by disrupting soil health.

Adverse effect of fertilizers on soil properties are given below

Soil Acidity & Depletion of nutrients: The use of chemical fertilizers may cause the soil to become acidic. Soil acidity may rise when chemical fertilizers contain ammonium-based compounds such as ammonium nitrate or ammonium sulphate. The chemical reaction that results from applying these materials to the soil releases hydrogen ions, increasing the acidity of the soil. The soil may grow increasingly acidic over time as a result of repeated chemical fertilizer applications. As a result, both plant growth and soil quality may suffer. An overly acidic soil can restrict nutrient availability and

make it more difficult for plants to absorb water, and plants require a specific pH range for optimal growth. Although overuse of chemical fertilizers may deplete soil nutrients, they do provide essential nutrients for plants. Only three macronutrients- nitrogen, phosphorus, and potassium as well as perhaps a few micronutrients are typically provided by chemical fertilizers. They don't, however, enrich the soil with organic matter, which is an essential source of nutrients for plants. If chemical fertilizers are applied often, they can eventually

reduce soil organic matter and deplete essential micronutrients.

Compaction of soil: Excessive use of chemical fertilizers can cause salts and other materials to build up, which can reduce the pore space between soil particles and increase soil density. As a result, it could be more difficult for roots to move through the soil and restrict a plant's capacity to absorb nutrients and water. Crop productivity is impacted by soil compaction. It may cause the soil's oxygen content to drop, which would hinder the growth of healthy soil organisms. Additionally, it may reduce the soil's ability to retain water, which affects crop yields and makes the area more vulnerable to drought. Moreover, erosion and other environmental issues can be exacerbated by compacted soil.

Nitrates and Water Contamination: The leaking of nitrates into groundwater is one of the main issues with chemical fertilizers. The need for prudent fertilizer application is highlighted by the potential major health problems that high nitrate levels in drinking water might present to both humans and animals.

Changes in pH Levels: Chemical fertilizers have the ability to change the pH of soil, increasing its acidity or alkalinity. This can hamper plant growth and have an impact on the availability of nutrients. Optimizing nutrition absorption requires careful pH control.

Depletion of Soil Structure and Organic Matter: A decrease in soil organic matter could result from an over-reliance on chemical fertilizers, which would inhibit the usage of organic materials. The preservation of soil structure, moisture retention, and nutrient exchange depend heavily on this organic matter.

Groundwater Pollution: The quality of groundwater can be affected by fertilizer use, particularly when too many nutrients seep into water sources. Compared to organic fertilizers, inorganic fertilizers have an increased tendency for leaching into groundwater because of their solubility. Nitrates is a type of nitrogen which are especially hazardous since they can pollute

provisions of consumption water. Human health may be harmed by high nitrate levels in water, particularly for little children and pregnant women.

Environmental pollution: Chemical fertilizers have numerous ways in which they might lead to environmental contamination. The discharge of surplus nutrients into surrounding water bodies from agricultural fields is one of the most important methods. Eutrophication, another name for this excessive nutrient discharge, can cause toxic algal blooms to develop, which can lower water oxygen levels and endanger aquatic life. Moreover, chemical fertilizer production uses a lot of energy, which raises the possibility of air pollution and greenhouse gas emissions. Chemical fertilizer manufacturing can also lead to the production of hazardous waste and pollution of the soil and water. Food crops may become contaminated with chemical residues as a result of the usage of chemical fertilizers.

Impact on soil organisms: Chemical fertilizers can affect soil organisms in both positive and negative ways. On the plus side, the addition of nutrients from chemical fertilizers can stimulate the growth of useful soil microorganisms, such as nitrogen-fixing bacteria, which can progress soil productiveness and stimulate plant growth. On the other hand, overuse of chemical fertilizers can damage soil life. Because soil microbes require a balanced pH, excessive use of chemical fertilizers can make the soil more acidic. This could lead to a reduction in the number and diversity of soil microorganisms, which could affect the overall health of the soil and its ability to support plant growth. Furthermore, an excessive amount of nutrients in the soil can promote the growth of harmful microorganisms, including some bacterial and fungal species, which can lower crop yields and cause plant illnesses. In addition to decreasing soil organic matter levels and causing soil deterioration, overuse of chemical fertilizers can also lower the activity of soil organisms responsible for breaking down organic matter.

There are a number of ways to reduce the harmful effects of chemical fertilizers.

Make use of Organic Fertilizers: Compost, manure, and other organic materials are natural suppliers of organic fertilizers. They can lower the threat of nutrient runoff and pollution while supplying nutrients to the soil and promoting the development of beneficial soil organisms.

Use of Cover Crops & Crop Rotation: In order to preserve and enhance the soil, cover crops are sown in between main crops. They can lessen the need for artificial fertilizers, enhance soil health, and lessen soil erosion. Crop rotation is the practice of gradually switching up the crops grown in the same field. This can lessen the need for chemical fertilizers, increase soil health, and lower the danger of plant illnesses.

Green Manure: Helps to maintain the organic matter status of soil. Provides a fast-growing food and energy supply for the bacteria, which also breaks down genetically modified organisms and releases plant nutrients in forms that crops can use. Green manures greatly enhance soil structure by infusing the soil with organic matter. Soil aggregates are formed when soil particles are bound together by organic

materials. Because of the creation of holes made possible by these larger particle clusters, the soil is able to retain water, distribute nutrients, and aerate itself properly. Such soils provide the ideal environment for plants to create a robust root system and make better use of the nutrients that are available.

Implement of Integrated Nutrient Management (INM) Practices: Crop residues, organic fertilizers, and other nutrient sources are used in conjunction with chemical fertilizers as part of the all-encompassing INM strategy. This can optimize nutrient utilization and reduce the negative impacts of chemical fertilizers on soil health and the ecosystem.

Implement Precision Agriculture Techniques: The use of technology, such as sensors and drones, to optimize the use of inputs, such as water and fertilizers, in accordance with the particular needs of each crop and soil type is known as precision agriculture. This may also reduce the use of chemical fertilizers while improving agricultural output and reducing environmental impacts.

Conclusion

Although chemical fertilizers are essential for plants, overuse of them can deplete the soil's nutritional supply. Sustained agricultural productivity requires the appropriate use of chemical fertilizers in conjunction with other techniques that preserve soil fertility and health.

Soil compaction brought on by excessive use of chemical fertilizers can harm soil health and crop productivity. Sustained agricultural productivity requires the appropriate application of chemical fertilizers in conjunction with other methods that preserve soil fertility and health.

References

1. Craswell, E. (2021). Fertilizers and nitrate pollution of surface and ground water: an increasingly pervasive global problem. *SN Applied Sciences*, 3 (4), 518.
2. <https://farmerline.co/the-impact-of-fertilizers-on-the-environment-inorganic-vs-organic/>
3. Krasilnikov, P., Taboada, M. A., & Amanullah. (2022). Fertilizer use, soil health and agricultural sustainability. *Agriculture*, 12 (4), 462.
4. Kumar, S., Dhyani, B.P., Singh, O., Kumar, S., (2023). Organic Fertilizer: An Eco- friendly Approach for Soil and Plant, *The Agriculture Magazine*, 2(9), 408-411
5. Pahalvi, H.N., Rafiya, L., Rashid, S., Nisar, B., Kamili, A.N. (2021). Chemical Fertilizers and Their Impact on Soil Health. In: Dar, G.H., Bhat, R.A., Mehmood, M.A., Hakeem, K.R. (eds) *Microbiota and Biofertilizers*, Vol 2. Springer, Cham. https://doi.org/10.1007/978-3-030-61010-4_1
6. Tiwari., H., Bhatt, R., Kumar, S., (2024). Green Manuring for Sustainable and Climate Smart Agriculture., *AgriGate- An International Multidisciplinary e-Magazine.*, 4 (5), 1-5.
7. Wick, K., Heumesser, C., & Schmid, E. (2012). Groundwater nitrate contamination: factors and indicators. *Journal of environmental management*, 111, 178-186.