

## Review on Impact of Chemical Fertilizers on Environment

Dr. Geeta Kandpal <sup>1</sup>

<sup>1</sup> Department of Agriculture, Sanskriti University, Mathura Uttar Pradesh-281401, India.

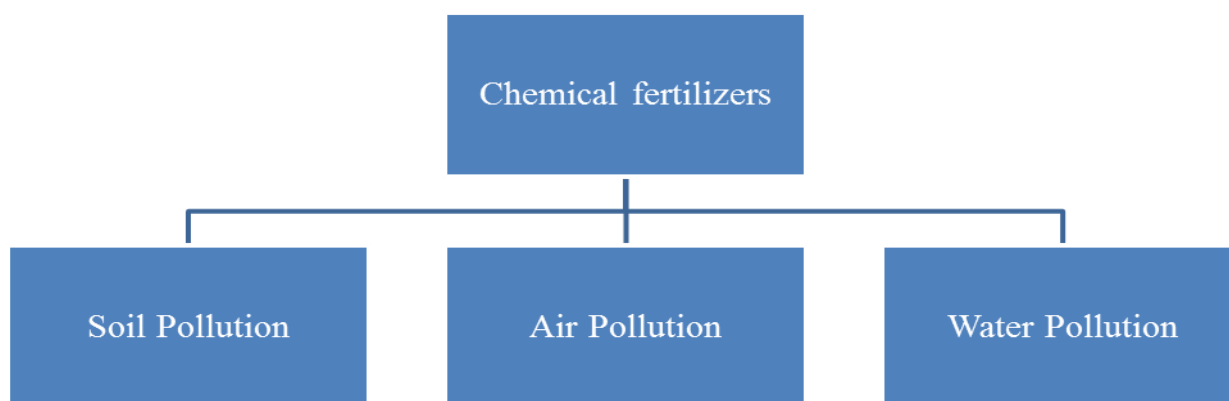
### Abstract

It is already known that for the quality production in agriculture, nutrition of plants is the most important aspect. Nutrient rates in soil affects the yield quality. In agricultural land, soil of the land in nutrients is poor, therefore, producers fertilize soil to increase the yield and quality. Many researches have shown extreme utilization of synthetic fertilizers for large scale plant production, however the consequence of which is environmental deterioration. Excess use of fertilizers can cause harmful effect on the environment. To reduce the adverse effect of the chemical fertilizers, organic fertilizers, bio fertilizers and Nano fertilizers have found to be more potent in increasing the productivity and with less or no side effects. The present review paper highlights the impacts of chemical fertilizers on the environment & use of alternatives of chemical fertilizers such as bio fertilizers, Nano fertilizers and slow released fertilizers to develop a healthy environment for present as well as future. In this review, objective to reveal the impact of the chemical fertilizer on the environment.

**Keywords:** Agriculture, Chemical Fertilizer, Environment, Plant Growth

### Introduction

Industrial revolution fulfilled food requests of rising population initiated an increases in the yield per unit in the productions of crop, but use of fertilizers also increase for the production of more yield in the agriculture. Less fertility of soil is the most common limitation in improving the production in agriculture [1]. Fertilization expanding the efficiency & achieves good quality of products retrieval the agriculture. Fertilization most common way to improve the production yield in the agriculture. But use of synthetic fertilizers in the agriculture caused environmental pollutions and several health problems. Fertilization can affect gathering of the heavy metals in plant system and soil. Plants absorbs the fertilizer from the soils and they can arrive in the food chain. Therefore, fertilization accelerates soil, and water and air pollution (Figure 1).



**Figure 1: Impact of chemical fertilizers on environment, excess use of chemical fertilizers causes different types of pollution such as Soil, Air, and water pollution**

For obtaining more products, more fertilizers will use in the next some years. But more use of inorganic/chemical fertilizers in the agriculture caused severe environmental problems due to some fertilizers contains some heavy metals and radionuclides in the high concentration.

#### 1. Fertilizers

A fertilizer, synthetic or natural material refers to material that contains chemicals to improve the growth and productiveness of the plants or soil by providing the essential nutrients[2]. Natural and industrial produced fertilizers also exist. Fertilizers should have at least 5% of 3 primary nutrients – Phosphorus (P), Nitrogen (N) and potassium (K). Industrial fertilizers are also called mineral fertilizers. Fertilizers contain major (Nitrogen, phosphorus and potassium) and minor (Zinc, Manganese, Iron), plant essential elements, and other non-essential element.

#### *Essential elements*

Essential elements can be divided into the micronutrients and the macronutrients. Nutrients that plants require in the maximum amounts are called as macronutrients. Macronutrients are essential for the plant growth. Macronutrients are subdivided into primary and secondary macronutrients.

#### *Primary Macronutrients*

- Phosphorus, it is involved in various processes of plants such as flowering and energy transfer.
- Nitrogen, it is the most important element of numerous plants substance such as chlorophyll which cause leaf growth.
- Potassium, it acts as an enzyme activator in the respiration and photosynthesis, movement of the water, fruiting and flowering.

#### *Secondary Macronutrients*

- Sulphur, it is structural component of vitamins, some amino acids and required for the nitrogen fixation by legumes & conversion the nitrate into the amino acids & after that into proteins.
- Magnesium, it is a constituent of the chlorophyll molecule in the plant nutrition also works as an effective activator in the various enzymatic reactions
- Calcium, It is involved in some plant enzyme activation along with regulation of the nutrients into the plants & also involved in the photosynthesis.

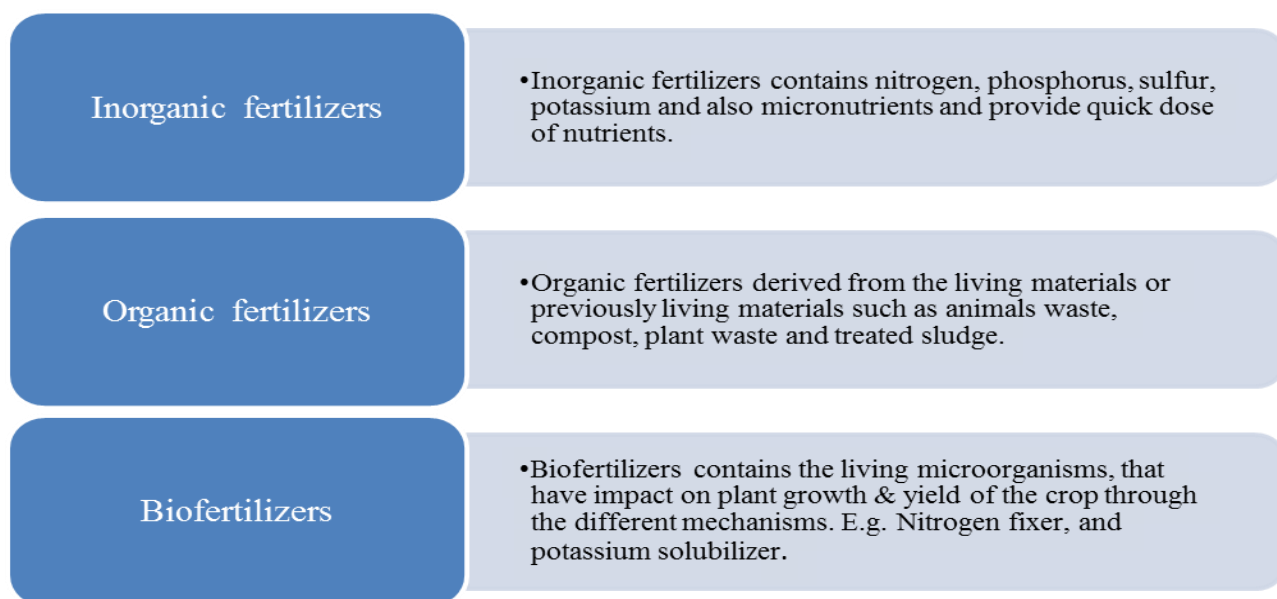
#### *Micronutrients:*

A vitamin, mineral, or the other substance that is essential and required in the less amount for the metabolism or growth. Micronutrients are:

- Copper, it is involved in the cell wall fabrication, production of grain and also important for the photosynthesis.
- Manganese, it is required for chloroplast making and photosynthesis.
- Iron, it is present as enzyme cofactor and required for the photosynthesis.
- Zinc, it plays important roles in the restatement of DNA and necessary for the enzymes.
- Boron, it affects the fruiting, flowering and cell division in the plants.

#### *Types of Fertilizers*

Fertilizers are classified on the basis of its nature of the nutrient present in the compound. On the basis of nature fertilizers can be classified in these types (Figure 2):



**Figure 2: Types of fertilizers on the basis of nature, Inorganic, organic and Bio fertilizers**

#### *Impact of Chemical fertilizer on natural resources*

Producers are using large number of pesticides, fertilizers and herbicides to achieve the more production but by using large amount of doses than standard or optimum of these fertilizers and chemicals. More doses of fertilizers accelerate the environmental pollution such as air pollution and water pollution, decrease food quality, disease, soil degradation and micronutrients deficiency in the soil. In spite of these problems, it is needed to match the demand of the food of growing populations. Hence, it is needed to produce the chemical free agricultural produce without effect on the natural resources.

However, use of fertilizers has a beneficial impact to the plant in providing the more nutrients and high nutrient content & its solubility makes it the more acceptable than the organic and bio fertilizers. There are many evidences that chemical fertilizers can increase the production significantly but use of chemical fertilizers also have disadvantages or negative effect on the environment[3] and ecosystem due to its decreasing nutrient use efficacy and growing consumption.

Chemical fertilizers helps plants to growing faster but the plants will not be healthy because of lack to natural time to grow properly. Although chemical fertilizers can cause root burn because chemical fertilizers not allow sufficient water intake [4]. Chemical fertilizers used in the food crops is not nutritious as compared to the others because of faster growth in plants. A study showed the excess concentration of fertilizers and pesticides in the ground water can compromise nervous and immune system of the young children [3]. Hence, the big challenge in the agricultural productions is to connected demanding cultivation with a great nutrient utilize effectiveness.

#### *Effect of Chemical fertilizers on soil*

According to a researches, impact of the chemicals fertilizer is not immediate on the soil due to high buffering power of the soil. Excess utilize of chemical fertilizer can guide to the soil crust & acidification thus reducing humus content, organic matters can change the soil pH & also distribute the greenhouse gases. The soil acidity reduces intake of phosphate the crops and increase the toxic ions in soil, thus inhibits growth of crop.

Impact of inorganic & organic fertilizers on the rhizosphere soils in the tea orchards were studied. For measuring the bacterial composition and the content of heavy metals high-throughput sequencing technology and Inductively coupled plasma mass spectrometry (ICP-MS) was used and the results concluded that organic fertilizer decreased the content of heavy metals in comparison to the inorganic fertilizers and it also indicated the use of organic fertilizers expressively decreased content of heavy metals in the tea leaves also [5]. Hence, it

was concluded that use of organic fertilizers increases the quality and reduce the heavy metal in comparison to inorganic fertilizers. Thus, use of organic fertilizers also improve the quality and production in the agriculture.

#### *Effect of Chemical Fertilizers on Air Pollution*

More use of the inorganic fertilizers for increasing the production of crop causes various dangerous greenhouse gases and depleting ozone protective layer[6]. When use of chemical fertilizers is much appeal, it causes the air pollution by emission of nitrogen oxides. There are various gases in atmosphere such as carbon dioxide, water vapor, hydrogen sulfide with the chlorofluoro hydrocarbons, methane, these gases contribute to the greenhouse effect. Atmospheric  $N_2O$  raises from 0.2 – 0.3% every year globally. Thus, in cases of excess uses of the nitrogenous fertilizers, particularly nitrate level of plants would intimidate the human's health level.

Alkaline and the calcareous soil, mainly applied to surface structure of the soil and  $NH_3$  fertilizers with urea, may results in the ammonia evaporation. A huge number of soils & the environmental factor may be organized & proportional to an ammonia concentration in soil solution. The ammonia emission by the fertilized lands, nearby to results in the depositing the vegetation damage & ecosystems. Ammonia can be oxidized and turn into the sulfuric and nitric acid from the industrial source and create the acid rain after the chemical transformations. The acid rain may destruct vegetation and it can harm organisms which they live in the reservoirs and lakes [7]

#### *Other Harmful effects of chemical fertilizers*

- By using the excess dose of the nitrogen fertilizer in the barley can caused the undesirable effect on the beer standard.
- The more use of chemical fertilizers, particularly nitrogen can cause crop tip browning, crop lodging and leaf yellowing. When the fertilizers burn the roots, roots of the plants can blacken & go limp. These symptoms rise because of accumulation of salt in the soil that causes exertion in water absorptions by plants.
- Over use of chemical fertilizers leads to turn plants leaves to brown or yellow and decreasing the production. Excess fertilization effects decrease biodiversity ensuing from the ammonia accumulation in the water and forests [6].
- Excess use of chemical fertilizers not only the hazardous for the environment but also to the animals, humans & microorganisms too.
- Chemical fertilizers cause disease in the plants. Chemical fertilizers have a high content of nitrogen as compared to the slow released organic fertilizers. When there is over amount of nitrogen in comparison to phosphate, plants are disposed to the mosaic infection.

#### *Alternatives of the chemical fertilizers*

Fertilizers improves the soil with nitrogen, potassium and phosphorous but more use of the chemical/inorganic fertilizers for the very long time to a similar soil accelerates to the humiliation of soil & loss of the microbes of the soil [6]. Hence, to enhance & sustainable production & to protect the environment, there are different alternatives of the chemical fertilizers like; organic fertilizers, slow release fertilizers and bio fertilizers (Figure 2). Use of combination of organic and inorganic fertilizers had a (+ve) effect on the biomass of the microbes & soil health [8].

#### *Bio fertilizers*

Bio fertilizers are substances which contains the microorganisms and helps in the stimulating the trees and plants growth by improving the essential nutrients to the plants. Bio fertilizers comprises living organisms that include blue green algae, bacteria & mycorrhizal fungi. Biofertilizers are different from the organic and

inorganic fertilizers that they don't supply the nutrients directly to the crops [9]. For Example: *Rhizobium*, *Azotobacter*, *Azospirillum*.

Biofertilizers are safe alternative of the chemical fertilizer to minimize the environment disturbance due to the use of chemical fertilizers. Biofertilizers are ecofriendly and cost effective and increase the crop yield upto the 10-40%. *Azotobacter*, gram negative bacterium in rhizosphere soil of various species of plants. Some species of the *Azotobacter* produce alginic acid, a compound majorly used in the food and medical industry. Apart from its ability of nitrogen fixing, it also synthesizes phytohormones like auxin and helps in promoting the plants growth [10]. Hence, biofertilizer is better alternative of chemical fertilizers as it contains microorganism and with less or no harmful impact on environment.

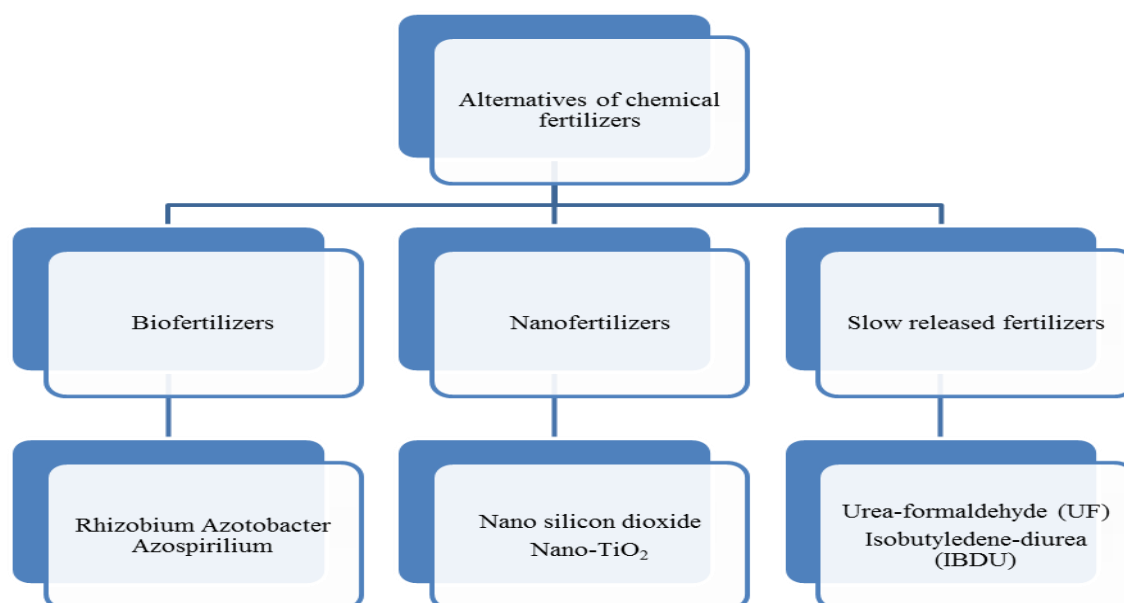
#### Nanofertilizers

Nanofertilizers are the nanomaterials and responsible for delivering the one or more types pf nutrients to the plants to improve the growth and production. They are the advance from of the traditional fertilizers, extracted from the different parts of the plant by use of different physical, chemicals, biological and mechanical techniques with the helps of the nanotechnology utilized to improve the fertility of the soil and productivity[11]. Depend on the requirement of plant nutrient, nanofertilizers is subdivided into macronanofertilizers, micronanofertilizers and nanoparticulate fertilizers. Effect of Nano-TiO<sub>2</sub> & non nano-TiO<sub>2</sub> on germination & growth of natural seeds of spinach were studied with measuring the germination rate & vigor indexes of spinach and the study concluded Nano-TiO<sub>2</sub> improves the growth of the seeds of spinach in comparison to non-nano-TiO<sub>2</sub>. Thus, Nanofertilizers improves the growth of the plants and can be the better alternative of the chemical fertilizers.

#### Slow release fertilizers

Slow release fertilizers involve release of nutrients in the slower rate than normal fertilizers. But pattern, rate and release duration are not the controlled well. Different slow release fertilizers are:

Urea-formaldehyde & Isobutyledene-diurea. Slow release fertilizer, shows significant advantage over chemical fertilizers, minimum loss of the nutrients and providing more nutrients to the plants with the time and also minimum chances of burn when applied in excess. Thus, slow release fertilizers are the another alternative of chemical fertilizers as it is cost effective and shows significant over use of chemical fertilizers.



**Figure 3: Alternatives of the chemical fertilizers and their examples. Biofertilizers, Nano fertilizers and slow released fertilizers can be used as the alternative of the chemical fertilizers**

## CONCLUSION

In agriculture, use of fertilizers is very necessary as it restore the nutrients of soil and increase the yield of production but excess use of chemical fertilizers caused harmful impact on the environment. Use of chemical fertilizers decrease the nutrition quality. To reduce the different kinds of the harmful effects because of the more use of the chemical fertilizers, soil analysis and testing should be done, then particular amount of fertilizer should be given. Alternatives of the chemical fertilizers should be adopted as biofertilizers, nanofertilizers and slow released fertilizers as they showed significant increase in production and also cost effective. Use of nanofertilizers and biofertilizers will develop healthy environment for present as well as future.

## REFERENCES

1. Ayoub, A.T., "Fertilizers and the environment," *Nutr. Cycl. Agroecosystems* 55(2):117–121, 1999, doi:10.1023/A:1009808118692.
2. Fertilizer | agriculture | Britannica.
3. The Hidden Dangers of Chemical Fertilizers -- Environmental Protection.
4. Harmful Effects Of Chemical Fertilizer.
5. Lin, W., Lin, M., Zhou, H., Wu, H., Li, Z., and Lin, W., "The effects of chemical and organic fertilizer usage on rhizosphere soil in tea orchards," *PLoS One* 14(5), 2019, doi:10.1371/journal.pone.0217018.
6. Savci, S., "An Agricultural Pollutant: Chemical Fertilizer," *Int. J. Environ. Sci. Dev.* 73–80, 2012, doi:10.7763/ijesd.2012.v3.191.
7. Shaviv, A., *Advances in controlled-release fertilizers*, *Adv. Agron.* 71:1–49, 2001, doi:10.1016/s0065-2113(01)71011-5.
8. Usman, M., Madu, V.U., and Alkali, G., "The Combined Use of Organic and Inorganic Fertilizers for Improving Maize Crop Productivity in Nigeria," *Int. J. Sci. Res. Publ.* 5(10), 2015.
9. What Is Biofertilizer?- Types And Importance Of Biofertilizers.
10. Ramasamy, M., Geetha, T., and Yuvaraj, M., "Role of Biofertilizers in Plant Growth and Soil Health," *Nitrogen Fixation*, IntechOpen, 2020, doi:10.5772/intechopen.87429.
11. Dharam Singh, M., Chirag, G., Prakash, P.O., Hari Mohan, M., Singh, R., and Manish Kumar, D., "Nano-Fertilizers is a New Way to Increase Nutrients Use Efficiency in Crop Production," *Int. J. Agric. Sci. Cit.* 9(7):3831–3833, 2017.