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Nitrate leaching from agriculture fields

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Nitrate leaching is a naturally occurring process, it occurs when mobile nitrate from the mineral nitrogen pool is washed out of the root zone by runoff. The main form of nitrogen that is leached is nitrate (NO3). Other forms of nitrogen, such as ammonium (NH4+), generally do not leach. Nitrate is very mobile therefore it can be easily transported by water. Manures, decompose of plants and other organic materials, fertilisers are possible sources of nitrates. When it is within the root zone, there is no issue, but if it enters the groundwater and other freshwater areas, it becomes an environmental hazard.

The amount of water that a soil can contain is a significant component that can influence the amount of leaching. In comparison to clay soil, nitrate leaching occurs far more readily in sandy soil. Nitrate leaching is governed by a number of factors that affect accumulation and movement of residual nitrate in soil. These factors include the nature of the plant, seasonal variations, climatic changes, the features of the soil, how much water the plants need, the amount of nitrate in the soil system, and others.

Nitrate leaching from agricultural fields

The nitrogen is most crucial nutrient for maximising crop potential and ensuring environmental sustainability but there is lacking of nitrogen in agricultural systems all over the world. Since the previous 60 years, nitrogen fertiliser has been discovered to be a potent strategy for enhancing crop productivity and addressing the demand of population expansion.

Leaching is the loss of water-soluble plant nutrients from the soil, due to rain and irrigation. The two main plant-available forms of nitrogen in soil are ammonium (NH4+) and nitrate (NO3+), with the

latter having a six-fold faster movement rate and being more susceptible to leaching loss. Leaching may also refer to the practice of applying a small amount of excess irrigation where the water has a high salt content to avoid salts from building up in the soil (salinity control). Where this is done, drainage is frequently needed to get rid of the extra water. A key pathway for nitrate entrance into the food chain is through the soil profile, where nitrate leaching causes low nitrogen utilisation efficiency and pollution of underground water streams. However, nitrate leaching and surface runoff pose a major hazard to people's health and seriously contaminate biological ecosystems when chemical nitrogen fertilisers are used in excess.

Effect of nitrate leaching

Globally nitrogen fertiliser use is typically connected to an increase in nitrate pollution of ground and surface water bodies. Nitrate, a frequent pollutant in both surface and ground waters, is composed of nitrogen. In agricultural soils, nitrate can easily leach down beyond the root zone and enter into the ground and surface waters. Nitrate renders groundwater unsafe for drinking when concentrations surpass acceptable permissible limits. Higher levels of nitrate in surface water bodies can cause eutrophication and threat to the aquatic ecosystem.

Once nitrates get into the groundwater, the greatest concerns are for infants less than one year old and for young or animals. Nitrate toxicity can cause anoxia, or internal asphyxia, in babies when levels are high. If nitrate concentrations are higher than the recommended health limit of 10 ppm, look for other water sources. To get rid of nitrates, don't boil the water. Instead of lowering the levels of nitrate, it raises them. The most typical sign of infant nitrate poisoning is bluish skin around the eyes and mouth of babies. The "blue-baby syndrome" is a frequent name for these signs of nitrate toxicity.

Management of nitrate leaching

Organic or conventional farming is not a factor in the management of nitrate leaching; rather, effective countermeasures must be implemented and used. Therefore, it is necessary to reduce nitrate leaching from agricultural soils by using appropriate techniques. To prevent excessive nutrient loss, elements such as soil structure, crop planting, fertiliser type and application rates, among others, are taken into consideration.

Farmers should choose high-yielding crops that remove a significant amount of nitrogen from the harvested portion, use the right fertiliser source, applied at the right rate, at the right time, and added in the right place, careful water management to retain nitrate in the root zone during the growing season, crop protection from weeds, pests, and disease, and eliminate any other factors that might restrict crop growth and nutrient removal in the harvest.

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To reduce groundwater contamination risks and nitrate leaching losses, numerous agronomic management techniques can be applied. As alternatives for managing soil, organic farming, conservation tillage, and growing crops during a season with a high risk of leaching are suggested. The essential components of irrigation management are evapotranspiration-based irrigation scheduling and prudent deficit irrigation use.

Environmental indices of fields, consideration of spatial variability within fields in relation to their contribution to leaching losses within a catchment, reduction of nitrogen inputs to soil to levels slightly below those expected to give the optimum yield by applying less nitrogen fertiliser and by a further reduction in animal density, and use of a variety of countermeasures (catch crops, minimum tillage, control of biological processes, etc.) depending on how sensitive the farming system, etc.

Simulation models are being used more frequently as effective tools for monitoring and forecasting nitrate pollution of surface and ground water. To lessen nitrate leaching into ground water, additional techniques like structural adjustments in agriculture, such as modifications in land use patterns based on different crops and crop rotations, should also be used.

Conclusion

Nitrate leaching from agriculture is a global issue with effects on the environment and human health. Concern arises when nitrate leaching adds to groundwater contamination. High nitrate concentrations in drinking water are linked to high nitrate levels in water leached from soils, and excessive amounts alter the natural equilibrium of water bodies. Therefore, it is must to reduce the leaching of nitrate from agricultural soils by applying appropriate agricultural practices. Hence, the prevention of nitrate pollution will ensure the clean and potable for all living beings exist on Earth.

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