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CAUSES AND EFFECT OF ACID RAIN – A REVIEW

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ABSTRACT

Acid rain is one of the major environmental threat since 19th century. This paper reviews the progress report of US EPA (2013) and the effects of acid rain on plants and human health. The changes are also summarized to indicate the significant effects.

Key Words – Acid Rain, Air pollutants, nutrient leaching.

INTRODUCTION

With the rapid industrial expansion and advancement of human civilization, the problem of atmospheric pollution has become alarming. Acidity in precipitation comes naturally by the dissolution of atmospheric carbon dioxide in water forming a solution that is weakly acidic having a pH value of 5.6, often called as 'natural baseline'. However other naturally occurring substances including oxidized Sulphur and Nitrogen gases can yield more acidic solutions at remote continental and marine sites (Galloway et al. 1982 Charlson and Rhode 1982).

The principal precursors of acid rain are emissions of Sulphur dioxide (SO_2) and nitrogen oxides (NO_2) but a variety of other emissions also influence acidity, notably hydrochloric acid, ammonia, volatile organic compounds and alkaline dust (Lee et.al. 1993). In case of SO_2 man made emissions are primarily the results of fossil fuel combustion while natural emissions arise in approximately equal proportions from terrestrial and marine sources (Moller, 1984) Emissions of oxides of nitrogen (NO_2) play an important role in acid deposition, both directly as precursors of acidity and because of their critical influence on the photochemical production of ozone and OH radicals, which play a major role in the atmospheric chemistry. The high temperature combustion of fossils fuel constitutes the major man-made source of NO_2.

Sulphur dioxide and nitrogen oxides are emitted into the atmosphere where they are oxidized and hydrolyzed subsequently to form Sulphuric acid and nitric acid. Available data indicate that approximately 60-70% of the acidity is ascribed to Sulphuric acid and 30-40% to nitric acid.

The relative proportion of nitric acid and Sulphuric acid derivatives may be an adequate indication of the nature of the source of the acid rain – a high proportion of NO_2 or nitric acid

derivatives suggest automobile or mobile sources while a high proportion of Sulphuric acid derivatives indicate stationary sources such as power plant, smelters and heavy industry (Hofmann and Schleyer,1994).

Acid deposition may be – wet deposition such as acid rain or fog or dry deposition such as deposition of particulate less then PM 2.5.

Effect of acid rain may either be chronic or episodic while the chronic effect is a long-term effect, episodic effect is due to heavy rain storm.Increase level of acid rain leads to nitrogen saturation in soils which adversely affect the presence of various minerals in the soil.

E**ffects of acid Rain** There are two basic ways by which acidic precipitation could have an impact on plants. Firstly, it can directly affect the foliarsurface of the plant itself thus acting on the leaf or stem. Secondly it can indirectly affect the plants through effect on the soil. For instance, the pH of rainfall which strikes the soil can change the rate at which nutrients are recycled, the speed with which litter and other organic materials are broken down through microbial action in the soil and the rate at which both macronutrients and micronutrients are leached from the soil into surface water or into ground water (Wood and Bormann 1975).

Acidity of rain has been implicated in decreased species diversity and decreased productivity in lakes and streams (Cogbill and Likens, 1974, Schofield 1976). Acidity of rain could also cause decreased pH and increased leaching of cations in soils with a low buffering capacity (Galloway et al. 1978). Altered rates of nutrients leaching have been demonstrated to occur if foliage is exposed to acidic rain water compared with more neutral rain water (Evans et.al 1982, Fairley and Lepp, 1975; Soherbatskoy and Klein 1989; Wood and Bormann 1975). A growing body of evidence suggests that acid rain is responsible for substantiate adverse effects on the public welfare. Such effects include the acidification of lakes and river with resultant damage to fish and other components of aquatic ecosystems, acidification and demineralization of soils, possible reduction in crop and forest productivity and deterioration of man-made materials.

Acid precipitation on vegetation reduces the photosynthesis and growth also increases the susceptibility to drought and disease process called 'dieback'. Younger seedlings are more susceptible than older plants (Sthan and Asthana 2001) adapted from Verma et al (2010).Acid rain also causes fading of the paint, therefore auto manufactures are coating vehicles with acid resistant top paint Similarly modern buildings are painted with acid resistant exterior wall paint.

Acid fog also reduces visibility by 50-70 in eastern USA causing agents of acid rain cause asthma., Particulate deposition of particles less than PM 2.5 can even reach the blood stream via lungs and cause harmful effects such as lung cancer.

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