Soil Acidity: A Recurrent Soil Constraint in Agricultural Lands of Odisha

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ABSTRACT

Soil Acidity as a Constraint: Soil Acidity is a long-standing constraint being faced by agricultural productivity in the context of the province of Odisha, located in the country of India. Recent estimates have found more than half of the agricultural lands in the province to be soil acidic in nature due to high rainfall, intense weathering, as well as continuous leaching of base cations (Government of Odisha, 2025). Soil Acidity can be defined as soils marked by aluminum toxicity, toxicities of metals such as manganese, phosphorus fixation, as well as low microbial populations (Sharma & Gupta, 2006). The present study compiles existing scientific research work on soil Acidity affecting agricultural lands within the province of Odisha.

INTRODUCTION

Soil acidity is one of the major chemical forms of land degradation in humid and sub-humid tropical regions (Lal, 2015). Acid soils occupy about 49 million hectares in India and are mainly concentrated in the eastern and northeastern parts of the country (Sharma & Gupta, 2006). Odisha, being characterized with dominant red and lateritic soils formed under high rainfall conditions, represents one of the most acid-prone states in eastern India (Mishra & Hota, 2012). The growth of crops and diversification becomes limited due to lower nutrient availability caused by soil acidity and often lowers profitability. Thus, it assumes critical

importance in the state from the perspective of sustainable agriculture.

Extent and Distribution of Acid Soils in Odisha

Recent soil survey reports and government records show that about 57% of the cultivated area of Odisha has soil pH below 5.5, which is moderately to strongly acidic in nature. Acid soils are predominantly distributed in districts such as Koraput, Kandhamal, Rayagada, Gajapati, Mayurbhanj, Keonjhar, and Sundargarh. These soils are mainly Alfisols and Ultisols with low base saturation and poor buffering capacity due to prolonged weathering and leaching.

Reasons for Soil Acidity in Agricultural Soils in Odisha

The process of soil acidity increment in Odisha is attributed to both natural and human-induced components. The high precipitation regime, ranging from 1400 to 1600 mm per annum, results in considerable leaching out of calcium, magnesium, potassium, and sodium from the soil exchangeable complex, thereby leading to a decrease in soil pH (Lal, 2015). The weathering process of iron- and aluminum-cemented substrates also accelerates soil acidity (Sharma & Gupta, 2006). Of the human-induced reasons, the use of ammoniacal fertilizers without liming treatment accelerates soil acidity via nitrification reactions (Barik *et al*., 2013). The removal of crop residues, along with low organic matter addition, also results in decreased soil buffering (Das *et al*., 2023).

Influence of Soil Acidity on Chemical and Biological Properties of Soil

Soil acidity has a great influence on nutrient availability as well as biological processes in the soil. In an acidic soil, aluminum and manganese are in a soluble form in high concentration, toxic to plants, as this retards the growth of roots as well as nutrient uptake (Sharma & Gupta, 2006). Phosphorus is less available in an acid soil as iron and aluminum oxides fix this nutrient, a serious limitation in the red and lateritic soil of Odisha (Mishra & Hota, 2012). In addition, effective soil biotic life, such as Rhizobia, phosphate solubilizers, is reduced in an acid soil, thereby reducing biological fixes of nitrogen (Lal, 2015).

Impact of Soil Acidity on Crop Growth and Productivity

Soil acidity has an adverse effect on the growth and productivity of crops, especially acid-sensitive crops like pulses, oilseeds, maize, vegetables, and groundnut (Barik *et al*., 2013). The toxicity due to aluminum causes stunted root systems and lessened root hairs, further reducing crop productivity. Recent field studies on cauliflower have been conducted in the Keonjhar district of Odisha, and results are that lime application with boron and farmyard manure improved the yield of cauliflower under acidic conditions. Though rice raised under submerged conditions exhibits a certain amount of tolerance to soil acidity, upland rice and non-rice crops incur considerable yield losses due to low soil pH (Mishra & Hota, 2012).

Management of Soil Acidity

Liming is the most feasible and highly recommended practice for improving acid soils. The addition of agricultural lime, dolomite, or basic slag neutralizes exchangeable aluminum, increases the soil pH, and makes nutrients more available (USDA-NRCS, 2014). Recent studies have come up with simplified approaches to estimate lime requirement based on the acid soils of Odisha. These have helped in the development of more efficient and cost-effective liming practices. Integrated nutrient management involving lime application in combination with organic

manures and balanced fertilizer application improves the buffering capacity of the soil and maintains long-term soil fertility.

Government and Institutional Initiatives of Odisha

The Government of Odisha considers soil acidity as one of the major production constraints and has implemented soil health management programs with lime application, soil testing, and farmer awareness campaigns for acidic regions up to 2025. In the SAFAR program initiated by the ICAR-NRRI, efforts have been made toward the sustainable reclamation approach through lime and other industrial by-products like basic slag, along with farmer training and participatory research. These initiatives aim at enhancing adoption of acid soil management technologies at the field level.

CONCLUSION

Soil acidity remains an ever-recurrent and serious problem for agricultural land in Odisha. It is influenced by climatic conditions and the inherent properties of the soil. Scientific evidence for successive research work suggests that liming and integrated nutrient management can substantially increase agricultural sustainability and the annual returns from agricultural land. Management of acidic soils through research-based recommendations and extension services remains crucial for agricultural sustainability.

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