International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 11 [2] June 2020 : 151-153
© 2020 Society of Education, India
[ISO9001: 2008 Certified Organization]
www.soeagra.com/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA REVIEW ARTICLE

DOI: .10.15515/iaast.0976-4828.11.2.151153

Management of Soil Acidity under Hill Ecosystem

Lekhika Borgohain[1*], Hemi Borgohain[2],Prem Kumar Barteey[3]
[1*&3]Department of Soil Science, Assam Agricultural University, Jorhat-13, Assam, India
[2]Department of Chemical Sciences, Tezpur University, Tezpur, Assam, India
[*]Email-id- lekhikaborgohain123@gmail.com

ABSTRACT
The hill region soils are generally acidic in nature due to wash out of the basic cations present in the soils. The low productivity of the agricultural sector in hilly areas is largely attributed to low and decreasing soil fertility due to many factors such as soil acidity, soil erosion, continuous cropping and inadequate sustainable soil fertility management. Soil acidity is a major problem for agricultural productivity worldwide. Acid soils account for about 4 billion hectare of the total world land area. Most acid soils are found in South and North America, Asia and Africa, due to extensive weathering and leaching. About 21 million ha of acid soils are found in North Eastern Region (NER). In Assam, more than 60% of soils are affected by soil acidity problem. Soil acidity affects crops in many ways and its effects are mostly indirect, through its influence on chemical factors such as aluminum (Al) and manganese (Mn) toxicity, calcium (Ca), phosphorus (P) and magnesium (Mg) deficiencies and micro-biological processes. Extensive review has been done from published and unpublished literature since three and a half decade to highlight the trend, development and soil acidity management under hill ecosystem. These include use of acid tolerant germplasm; improved agronomic, cultural and biological practices and balanced use of fertilizers. Benefits of soil ameliorant such as lime etc were found to enhance soil health by improving soil pH, base saturation, calcium and magnesium. Besides, reduction in Aluminium and Manganese toxicity it induces increased P uptake in high P fixing soil through its beneficial effect on plant rooting environment.
Key words: Soil, acidity, nutrients, lime, hill region

Received 20.02.2019 Revised 22.05.2019 Accepted 01.07.2019

CITATION OF THIS ARTICLE
L Borgohain, H Borgohain, P K Barteey.Management of Soil Acidity under Hill Ecosystem. Int. Arch. App. Sci. Technol; Vol 11 [2] June 2020: 151-153

INTRODUCTION

A hill may refer to a particular section of flat terrain without a massive summit.The total forest cover is around 7,082,730 sq. km, which is about 21.54 percent of the total area of the country. The forest area may be differentiating into dense, moderately dense and slightly dense forest.Hill States in India with only 18 percent of geographical area of the country account for 34 percent of the total forest cover and in between 2015-17, India has added 6,778 sq.km of forest area.The low productivity of the agricultural sector in hilly areas is largely attributed to low and decreasing soil fertility due to many factors such as soil acidity, soil erosion, continuous cropping and inadequate sustainable soil fertility management.About 21 million ha of acid soils are found in NEH(North Eastern Hill) region including Sikkim with maximum area under Arunachal Pradesh (6.8 Mha) followed by Assam (4.7 Mha), Meghalaya, (2.24 Mha), Manipur (2.19 Mha) and Mizoram (2.0 Mha).Soil acidity is associated with hydrogen (H), aluminium (Al), iron (Fe) and manganese (Mn) toxicities to plant roots and corresponding deficiencies of plant available phosphorous (P), molybdenum (Mo), calcium (Ca), magnesium (Mg) and potassium (K), which negatively affects soil fertility and productivity.In acid soils with a high mineral content, the primary factor limiting plant growth is Al toxicity.

CAUSES OF SOIL ACIDIFICATION UNDER HILLY REGION:

Soil acidification rates are a function of the total H^+ ion equivalents added or generated in the soil and the buffering capacity of the soil [4]. In the case of plant induced processes, reactions that causes acid generation are carbon assimilation [6, 7], uptake and assimilation of nitrogen [2, 3] and uptake and assimilation of sulphur [5]. Also, regular ammonium based fertilizer use is one of the major contributors of soil acidification under managed ecosystems.The Al released from soil minerals under acid conditions occurs as $Al(OH)^{2+}$, $Al(OH)$ and $Al(H_2O)^{3+}$, which is also a source of acidity to the soil causes toxicity and greatly reduced yield and crop quality [8-10]. Also, researchers have found that soil acidification can be induced by elevated CO_2 [3].Long term application of nitrogenous fertilizers at higher rate significantly decreases the soil pH and exchangeable bases(Ca^{2+} and Mg^{2+}) but significantly increases the exchangeable Al [9].

MANAGEMENT PRACTICES

Liming is an important practice to achieve optimum yields of all crops grown on acid soils.Application of lime at an appropriate rate brings several chemical and biological changes in the soils, which are beneficial or helpful in improving crop yields on acid soils. The liming of acidic soils result in the release of P for plant uptake; this effect is often referred to as "P spring effect" of lime [2]. The effectiveness of liming materials also depends on the organic matter of the soil.The highest values of buffering capacity index (BCI=1.49) and LR (18 t ha-1) was associated with the soil with highest OM content (4.89%). Similarly; the lowest BCI (0.55) and LR (5.6 t ha-1) was found in the soil having the lowest OM content (1.03%). OM content of soil was strongly correlated with BCI ($r= 0.824^{**}$, $p< 0.01$) and LR ($r= 0.862^{**}$, $p< 0.01$) [12]. Evidences are also there that the management of acid soil can also be done by application of burnt lime which contains about 92.5% $CaCO_3$. [11]

FUTURE STRATEGIES

There is a need of complete database of acidity affected areas to know its trend so that it will be helpful in demarcated the area which have low acidity, medium acidity and highly acidity.The data should be user interface in the form of GPS or GIS based.Moreover balance fertilization should be adopted and research should be done to develop acid tolerant varieties. Industrial waste such as Paper Mill Sludge (PMS), Spent lime(sugar factory waste), also waste like Bagasses, oilcakes etc. can be used as ameliorant.

CONCLUSION

Soil acidity is a major problem for agricultural productivity worldwide. No doubt, Liming is an important practice to achieve optimum yields of all crops grown in acid soils. But there are also some other management practices by which we can control soil acidification processes. Development of acid tolerant crop, Balance fertilization, intense grazing practices and modified cropping practices will also reduce the soil acidity to a great extent. Integrated Nutrient Management(INM) also plays a major role in reducing the soil acidity in hilly areas.

REFERENCES

1. Barman, M, Shukla, L.M.,Datta, S.P. and Rattan, R.K. (2014).Effect of applied lime and boron on the availability of nutrients in an acid soil. J. Plant Nutr. 37(3): 357-373.
2. Bolan,N.S., Herdley,M.J. (2003).Role of Carbon, Nitrogen and Sulfur cycles in soil acidification."*Handbook of soil acidity*". New York: Rengel.Z: p. 29-56
3. Chand, J. P and Mondal, B. (2000).Nature of acidity in soils of West Bengal.*J. Ind.Soc. Soil Sci.* 48: 20-26.
4. Coote,D.R., Singh,S. and Wang,C.(1989). A proposed methodology for assessing the relative impact of acid rain and nitrogenous fertilizers on acidity of agricultural soils in Canada.*Can .J. Soil Sci.* 69: 611-627
5. Ezekiel, A.A. (2006). Strategies for improving crops use-efficiencies of fertilizer nutrients in sustainable agricultural systems.*Pakistan J. Nutr.*5(2): 85-193.
6. Fageria, N.K., Baligar, V.C. (2008). Ameliorating soil acidity of tropical oxisolby liming for sustainable crop production. In. SPARKS DL, editor. *Advances in Agronomy*.99.Brazil: Academic press. p 345-389

7. Felle, H.H., (1988). pH Regulation in Anoxic Plants.*Annals of Botany*. 96: 519–532
8. Godsey, C.B.; Pierzynski, D.B and Mengel, R.E. 2007.Evaluation of common lime requirement methods.*Soil Sci. Soc. Ame. J.* 71: 843-850
9. Jackie, L. S.; Zhang, H.; Girma, K.;Raun, W.R. and Penn, C.J. 2010.Soil acidification from long-term use of nitrogen fertilizers on winter wheat.*Soil Sc. Society of American Journal*. 75: 957-964
10. Jovanovic Z.,Djalovic, I. and Kovacevic.M.2006. Influences of liming on vertisol properties and yield of field crops.*Cereal Res.Commun*. 34: 517-520
11. Kisinyo P. O., Opala P. A., Gudu S. O., Othieno C. O., Okalebo J. R., Palapala V. and Otinga A. N.2012. Recent advances towards understanding and managing Kenyan acid soils for improved crop production. African J. of agricultural research.9 (31):2397-2408
12. ManoJ, K; Hazarika, S.; Choudhury, B. U.; Ramesh, T.; Verma, B. C. and Bordoloi, L. J. 2012.Liming and Integrated Nutrient Management for Enhancing Maize Productivity on Acidic Soils of Northeast India.*Indian Journal of Hill Farming*. 25(1):35-37