# IMPACT OF PEDOGENIC IRON AND ALUMINIUM ON SOIL ACIDITY COMPONENTS UNDER CONTRASTING LAND USES IN GOLAGHAT DISTRICT OF ASSAM

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## ABSTRACT

To illustrate the kind of soil acidity in affinity to various types of iron (Fe) and aluminium, five pedons representing varied land uses in Assam were examined (Al). Several extractants were used to extract the iron and aluminium, and the largest amount was found in the form that could be extracted from dithionite. Mostly because of monomeric $Al^{3+}$ ions, exchangeable $Al^{3+}$ made up the majority of the acidity. The level of variable charge present in the soils was shown by the contribution of pH dependent acidity, which outperformed all other types of acidity (more than 90%) in terms of total potential acidity in all the pedons. According to a correlation study, the most active forms of Fe and Al, $Fe_d$ and $Fe_p$, are $Al_p$, $Al_{KCl}$, $Al_{NH4OAc}$, and $Al_{cryst}$. These compounds also significantly contributed to soil acidity. By taking the most crucial data from 27 soil features and representing it as a group of new orthogonal variables called principle components, principal component analysis further provided a clear picture.

**KEYWORDS**: **Iron, aluminium, acidity, land uses, principal components**

## CONCLUSION

The results of this study showed that differing types of Fe and Al, which are significant contributors to soil acidity, may cause soils grown under distinct land uses to develop soil acidity to varying degrees. Regardless of the type of land use, the principal component analysis showed that different forms of Fe and Al, including KCl extractable Al, amorphous organic and inorganic Al, free oxides of Fe and Al, crystalline forms of iron, Fe and Al organic complexes, and amorphous organic and inorganic iron, all contributed to the development of soil acidity. Hence, it is advised that in addition to crops that can withstand acidity, like tea, traditional acid soil management and/or reclamation measures, interspersed with suitable land use and management practises, are essential to prevent the development and/or lessen the effects of soil acidity.

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## REFERENCES

1. Sen, T. K., Nayak, D. C., Dubey, P. N., Chauhan, G. S. and Sehgal, J. Chemical and electro-chemical characterization of some acid soils of Assam. Journal of the Indian Society of Soil Science, 1997; 45: 245-249.
2. Coleman, N. T. and Thomas, G. W. In Soil Acidity and Liming, American Society of Agronomy, Madison, Wisconsin, 1967 ; *p*. 1.
3. Bera, R., Seal, A., Banerjee, M. and Dolui, A. K. Nature and profile distribution of iron and aluminum in relation to pedogenic processes in some soils developed under tropical environment in India. Environmental Geology, 2005*;* 47: 241-245.
4. McKeague, J. A. and Day, J. H. Dithionite and oxalate extractable Fe and Al as aids in differentiating various classes of soils. Canadian Journal of Soil Science,1966; 46: 13–22.
5. Chatterjee, R. K. and Raghumohan, N. G. Micromorphology of some typical soils occurring in a sequence of increasing drainage. Indian Agriculturist, 1982 ; 26: 19-28.
6. Kalita, P., Kumar, S., Dutta, D., Dhyani, B. P., Naresh, R. K., Shahi, U. P. and Singh, B. Soil potassium fractions under prominent rice-based cropping systems of Meerut, Uttar Pradesh. Scientist. 2022. 1(3). 3000-3007. DOI: https://doi.org/10.5281/zenodo.7319292
7. Black, C. A. '*Methods of soil Analysis'* Part 2. Chemical and Microbiological Properties. American society of Agronomy, 1965; Madison, Wisconsin, USA
8. Piper, C. S. Soil and plant analysis. The University of Adelaide. 1966; Australia.
9. Jackson, M. L. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., 1973 ; New Delhi.
10. Mehra, O. P. and Jackson M. L. Iron oxide removal from soils and clays by a Dithionate-citrate system buffered with sodium bicarbonate. Clays Clay Miner, 1960*;* 7: 317-327.
11. Loveland, P.J. and Digby, P. The extraction of Fe and Al by 0.1 M pyrophosphate solution : A comparison of some techniques. Journal of Soil Science, 1984; 35: 243-250.

12. Olson, R. V. and Carlson, C. W. Iron chlorosis of sorghum and trees as related to exchangeable soil iron and manganese. Proceedings of the Soil Science Society of America, 1950; 14: 109-112.
13. Krishna Murti, G .S. R., Moharir, A. V. and Sharma, V. A. K. Spectrophotometric determination of iron with Orthophenanthroline. Microchemical Journal, 1970 ; 15: 585-589.
14. Krishna Murti, G. S. R., Sarmah, V. A. K. and Rangaswamy, P. Spectrometric determination of aluminium with aluminon. Indian Journal of Technology, 1974 ; 12: 270-271.
15. Kappen, G. Pochvennaya kislotnost, selkhogiz, Moscow. Journal of Indian Society of Soil Science, 1934; 39: 246.
16. McLean, E. O., D. C., Reicosky. and C, Lakshamanan. Aluminium in soils. VII. Interrelationships of organic matter, liming and extractable aluminium with permanent charge and pH-dependent CEC of surface soils. Soil Science Society of America Proceedings,1965*;* 29: 374-78.
17. Hesse, P. R. A text book of soil chemical analysis, John Murray (Publishers) Limited, London. 1971 ; http://dx.doi.org/10.1016/0341-8162(88)90013-6
18. Mondal, G. K., Pal, S. K. and Roy, A. Characterisation of acidity under different land use patterns in Tarai soils of West Bengal. Agropedology, 2006*;* 16(1): 21-25.
19. Cabrere, F. and Talibudeen, O. European Journal of Soil Science, 1977 ; 28: 259.
20. Paasikallio, A. and Hakkinen, U. Acid ammonium acetate and acid ammonium acetate/ EDTA as extractants for phosphorus-32, aluminium and iron in soils. Annales Agriculturae Fenniae, 1977; 16: 227-337.
21. Dolui, A. K. and Mondal, A. Influence of different forms of iron and aluminium on the nature of soil acidity of some Inceptisols, Alfisols, and Ultisols. Communications in Soil Science and Plant Analysis, 2007 ; 38: 119-131.
22. Mclean, E. O, Heddleson, M. R. and Post, G. J. Aluminium in soils: III. A comparison of extraction methods in soils and clays. Soil Science Society of America Proceedings, 1959 ; 23: 289-293.
23. Tan, K. H. Variations in soil humic compounds as related to regional and analytical differences. Soil Science, 1978; 125: 351-357.
24. Parfitt, R. L. and Childs, C. W. Estimation of forms of Fe and Al – A review, and analysis of contrasting soils by dissolution and Mossbauer methods. Australian Journal of Soil Science, Soil Solutions for a Changing World, 1988; pp. 1-6.
25. McKeague, J. A., Brydon, J. E. and Miles, N. M. Differentiation of forms of extractable iron and aluminium in soils. Soil Science Society of America Journal, 1971; 35: 33-38.
26. Jersak, J. M., McColl, J. G. and Hetzel, J. F. Changes in extractability of iron, aluminium and silicon and dispersibility by storage of California forest soils. Communications in Soil Science and Plant Analysis, 1992 ; 23: 993-1018.
27. Borggard, O. K. Phase identification by selective dissolution technique. In: Stucki S. W., Goodman, B. A., Schwertmann U (eds) Iron in Soils and Clay Minerals. D. Reidel, Boston, MA, 1988; pp. 93–98.
28. Sahoo, A. K., Sarkar. D., Baruah, U. and Butte, P. S. (2010) Characterisation, classification and evaluation of soils of Langol Hill, Manipur for rational land use planning. Journal of the Indian Society of Soil Science, 1966; 58 (4): 355-362.

29. Bandyopadhyay, S., Dutta, D., Chattopadhyay, T., Reza, S. K., Dutta, D. P., Baruah, U., Sarkar, D. and Singh, S. K. Characterization and classification of some tea-growing soils of Jorhat district of Assam. Agropedology, 2014; 24: 138-145.
30. Brady, N. and Weil, R.R. The Nature and Properties of the Soils. 13th Edition, Prentice-Hall, Inc., Upper Saddle River, 1996 ; p. 960.
31. Abreu, C. H., Muraoka, T. and Lavorante, A. F. Relationship between acidity and chemical properties of Brazilian soils. Scientia Agricola, 2003; 60(2): 337-343.
32. Thomas, G. W. and Hargrove, W. L. The chemistry of soil acidity. In: ADAMS, F. (Ed.) Soil acidity and liming. Madison: ASA, CSSA, SSSA, 1984; cap.1, pp. 3-56.
33. Sarkar, A. K. Acid soils their chemistry and management. New India Publishing Agency, 2013; New Delhi.
34. Bhat, J. A., Kundu, M. C., Mandal, B. and Hazra, G. C. Nature of acidity in Alfisols, Entisols and Inceptisols in relation to soil properties. Communications in Soil Science and Plant Analysis, 2017; 48 (4): 395-404.
35. Adams, F. Soil solutions. In: *The Plant Root and its Environment*, Carlson, E.W. (ed.), University of Virginia Press.: Charlottesville, Va, 1974; pp. 441-481.
36. Meshram, S.G., and Sharma, S.K. Prioritization of watershed through morphometric parameters:a PCA-based approach Appl Water Sci., 2017*;* 7**:** 1505–1519.
37. Dutta, M., Deka, B., Karmakar, R. M., and Kalita, P. Fertility Potential Classification of Soils of Tipukjan Watershed of Assam, India Using Principal Component Analysis. Scientist. 2022. 4913-4924. DOI: https://doi.org/10.5281/zenodo.7527702