Management of Acid Soils of NE Region

Introduction

The acid soils occur primarily in high rainfall, hilly/mountainous and coastal regions. The soils are under different land uses for growing of food crops, horticulture & plantation crops and forests. The highly leached soils are generally poor in fertility and water holding capacity. A substantial area with pH value less than 5.5 is more problematic with severe deficiencies of phosphorus, calcium, magnesium and molybdenum and toxicities of aluminium and iron. The average productivity of one tonne/ha of the soils is very low. The poor soil resource is one of the main factors of poverty and backwardness in the acid soil regions. The addition of lime to these soils neutralizes soil acidity and creates favorable environment for microbial activity, nutrients release and their availability to plants.

Extent and Distribution of Acid Soils in NE Region

About 21 million ha of acid soils are found in NEH region including Sikkim (Figure 1 & 2. Table 1) 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). The area covers both rable and non-arable lands. The soils are predominantly acidic in nature in all the states except in Assam where about one-third of soils were non-acidic in nature. A major chunk of area in Arunachal Pradesh (4.8 Mha) falls under the category of strongly acidic soils (pH<4.50. The districts having relatively more area under acid soils are East Khasi Hills & West Khasi hills of Meghalaya, Tuensang & Kohima in Nagaland, Aizawal in Mizoram, West Siang & Dibang valley in Arunachal Pradesh, Churachandpur in Manipur, Karbi Anglong in Assam, West Tripura & South Tripura in Tripura and North Sikkim in Sikkim.

Table 1. Extent of the acid soil in NE region (million hectares)

States	pH <5.5	pH 5.5.-6.5	Total acid soil	Geog. area	% Geog. area under acid soil
Arunachal Pradesh	6.52	0.27	6.79	8.347	81.08
Assam	2.33	2.33	4.66	7.844	59.41
Manipur	1.87	0.32	2.19	2.233	98.07
Meghalaya	1.19	1.05	2.24	2.243	99.87
Mizoram	1.27	0.78	2.05	2.208	97.20
Nagaland	1.60	0.05	1.64	1.658	99.50
Sikkim	0.60	-	0.60	0.710	84.51
Tripura	0.81	0.24	1.05	1.049	100.00
Total NER	**16.19**	**5.04**	**21.23**	**26.29**	**80.79**

Management of acid soils:

1. **Use of liming materials**

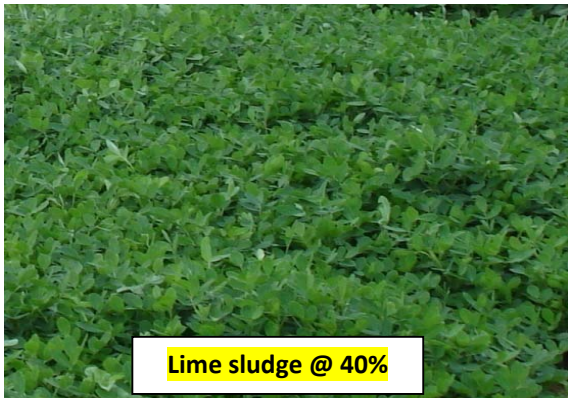
Addition of lime neutralizes soil acidity, increases microbial activity & nutrient availability and improves the physical condition of soil. Among the naturally occurring lime sources calcite and dolomite are important. In Assam about 15 Mt of limestone are available. The limestone availability in the North-Eastern Hill Region is reported to be 14 Mt. The agricultural grade limestone powder and marketable lime are effective but may not be available in plenty at all places and under such circumstances industrial by product particularly paper mill sludge could serve as cheap liming material. In Assam , Jagiroad Paper Mill produces 448 t of sludge everyday which is experimentally proved as an excellent liming material for reclamation of acid soils.

Rate of Application: Furrow application of lime (80 mesh size) @ 200-400 kg/ha in uplands (rainfed /irrigated) and medium land situations with pH<5.5. The rate may be somewhat higher for fine textured and organic matter rich soils. It should be applied with basal dose of fertilizers (part of N + full dose of P & K) manually or through seed cum fertilizer drill at the time of sowing. Any prevalent cropping system involving crops viz. rapeseed, mustard, greengram, soybean, ground nut, lentil, pea, linseed, pigeonpea, maize etc. may be followed as lime is to be applied to every crops.

Furrow application of lime

Maize without Lime

Maize with lime



Response of groundnut to lime sludge and agricultural lime

2. **Use of organic manures:**

Regular application of well decomposed organic matter in acid soils is essential to prevent sudden fluctuation of soil pH as it improves the buffer capacity of soils. Moreover, it increases the availability of P and reduces the toxicity of Fe and Al in acid soils. Fresh mulches (mostly weed biomass) of Ambrossia, Lantana etc. also reduces the adverse effect of soil acidity substantially.

3. Nutrient management :

- Integration of organic and inorganic sources of nutrients along with lime. Application of organic manures in combination with inorganic fertilizers and lime proves to be an excellent package for improving productivity and health of acid soils. Application of FYM @ 5t/ha along with lime @ 10% of lime requirement and inorganic fertilizers @ 50% of recommended dose has consistently increased soybean productivity by 60%, groundnut by 70% and maize by 33% over recommended dose of fertilizers.
- Phosphorous deficiency is more conspicuous in the acid soils of North Eastern States. The problem of P deficiency in the acid soil regions has to be tackled largely through the application of adequate amount of suitable type of P fertilizer and by adoption of proper management practices. In most of the acid soils, sizable amount of the applied water soluble P (eg. SSP, DAP etc) gets fixed and becomes unavailable to plants. Without adequate P, root growth is restricted particularly in the presence of high concentration of soluble Al and Mn. Superiority of rock phosphate or mixture of rock phosphate and super phosphate in suitable

proportion (3:1 or 1:1) depending on the pH of the soil, over superphosphate alone has been established. In unlimed soil, use of rock phosphate would reduce the expenditure on P fertilization because of its residual effect on subsequent crops. Rock phosphate can be used to its best advantage by application to a legume in *rabi* season and the residual effect being utilized in the following *kharif* upland crops. Application of indigenous rock phosphate as a source of P in long duration crops (eg. horticultural crops) hold promise.

- Iron toxicity is a problem in some parts of Assam and Meghalaya in low land rice. Improving drainage facility by excavating deep drains around fields, checking lateral seepage of water carrying Fe by constructing check embankments across the slope with provision of diversion weirs and liming have been successfully used to check iron toxicity. Application of 60 kg K_2O per hectare have given encouraging results.

4. Crop Scheduling

As a rule of thumb, under rainfed conditions (where effects of applied liming material weaken rather quickly), highly responsive crops like cotton, soybean, pigeon pea, groundnut, frenchbean etc. should be grown in the first year of liming. This should be followed by medium responsive crops like maize and wheat in the subsequent seasons. Cultivation of lowest responsive crops like millets, rice, barley, linseed etc. should be done in the last season/ year prior to commencement of the next liming schedule.

5. Crop diversification: Location specific crop diversification with acid tolerant crops like tea, groundnut, , maize etc. should be followed.

6. **Selection of suitable crops and varieties**

One of the main points of consideration while choosing crops has to be the local needs and preferences besides their agricultural suitability therein. Traditionally, farmers of acid soil regions have been growing rice irrespective of the type of land (Upland, Medium land & low land). Rice has certain degree of tolerance to soil acidity. On the other hand, cultivation of highly sensitive (towards soil acidity) field crops such as soybean, french bean, pigeon pea etc. should be tuned accurately to liming and/or other ameliorative measures. The horticultural crops are seen to have tolerance or affinity to specific soil pH and according to soil reaction these are classified into following groups:

i) Slightly tolerant to acid soils
ii) Moderately tolerant to acid soils
iii) Highly tolerant to acid soils

The horticultural crops grown in the NE Region along with their acidity tolerance are given hereunder:

Relative tolerance of fruit crops to soil acidity

Slightly tolerant to acid soil (pH 6.8-6)	Moderately tolerant to acid soil (pH 6.8-5.5)	Highly tolerant to acid soil (pH 6.8-5)
Mango	Pineapple	Strawberry
citrus	Orange	Gooseberry
Banana	Litchi	Bel
Guava	Passion fruit	Elephant apple
Papaya	Jackfruit	Plum
Cashew		
Carambola		
Apple		
Peach		
kiwifruit		

Relative tolerance of vegetable crops to soil acidity

Slightly tolerant (pH 6.8-6)	Moderately tolerant (pH 6.8-5.5)	Highly tolerant (pH 6.8-5)
Beet	French bean	Potato
Broccoli	Lima bean	Sweet potato
Cabbage	Carrot	Chow-chow
Cauliflower	Cucumber	Yam
Celery	Brinjal	Dioscoria *spp*
Spinach	Knolkhol	
Chinese cabbage	Pea	
Leek	Chilli	
	Pumpkin	

	radish
	Summer squash
	Winter squash
	Tomato .
	Colocasia

7. Live stock based farming system and multiple use of manure for field application & biogas production. Biogas slurry excellent source of organic manure.

8. Adoption of integrated farming system approach (complimentarity of crop-animal-fish-birds-multipurpose trees-horticulture) for household food security and efficient resource utilization.

9 Agro-forestry intervention with use of multi purpose tree species and hedge row species for stabilization of hilly slopes along with productivity augmentation.