

Dynamics and interrelationships of iron and acidity in hydromorphic rice systems of south western coastal India

Kamarudheen P^a., Mayadevi M. R^{a*}, Smitha J. K^a, Beena V. I^a. Jayasree P^a.,
Sandeep S^b, Archana K^a, Aryadevi J. S^c

^a Department of Soil Science, College of Agriculture, Kerala Agricultural University,
Kerala

^bKSCSTE -Kerala Forest Research Institute, Peechi

^cCollege of Forestry, Kerala Agricultural University, Kerala

* Assistant Professor, Department of Soil Science, College of Agriculture, Kerala
Agricultural University, Thrissur, Kerala

Ph. No. 9495167312

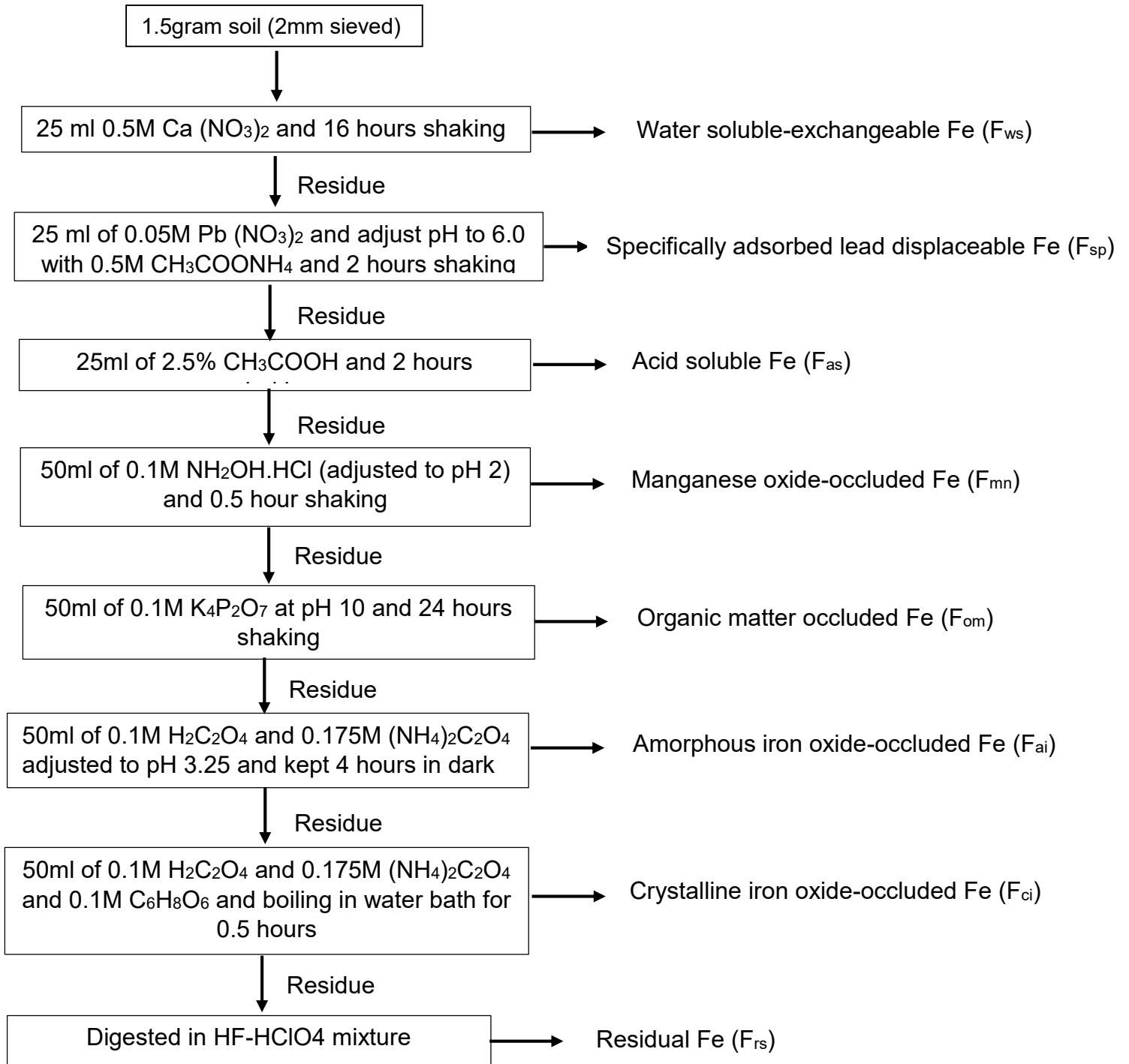
Email: mayadevi.mr@kau.in (Mayadevi M R)

Data sets of all sampling locations for reference (Submitted as Supplementary Materials (SM))

SM1. Description of sampling locations (Refer Fig. 1)

AEU	Sampling locations	GPS Coordinates	
1. <i>Kari</i> soils (AEU4)	Ambalapuzha	9°22'39.391"N	76°22'50.836"E
	Chathurthiakari	9°27'48.672"N	76°24'41.446"E
	Karumadi	9°22'20.885"N	76°23'19.474"E
2. <i>Pokkali</i> lands (AEU5)	Thathapilly	10°7'25.342"N	76°16'6.873"E
	Kaitharam	10°6'48.283"N	76°13'58.188"E
	Pannakkad	10°7'39.432"N	76°15'17.027"E
3. <i>Kole</i> lands (AEU6)	Arimbur	10°29'35.398"N	76°10'31.738"E
	Pullazhi	10°31'17.9"N	76°9'24.667"E
	Kololamba	10°44'34.948"N	76°0'0.162"E
4. <i>Kaipad</i> lands (AEU7)	Cherukunnu	12°0'5.342"N	75°17'24.853"E
	Ezhome	12°2'17.812"N	75°18'0.676"E
	Pattuvam	12°0'52.978"N	75°18'55.069"E
5. North Central laterites of Thrissur (AEU10)	Kottepadam	10°32'57.012"N	76°17'1.201"E
	Kaiparambu	10°35'42.101"N	76°7'57.741"E
	Mulamgunnathkavu	10°37'49.782"N	76°11'37.752"E

SM2. Flow chart of sequential fractionation of Fe in soil (Iwasaki and Yoshikawa (1990) (Refer **Materials and Methods**)



SM3. Chemical characteristics of rice growing Soils in Kerala (Refer table 3)

AEU	Location	pH	EC (ds m⁻¹)	WBC (%)	CEC (cmol (+)⁻kg⁻¹)	0.1M BaCl₂ - Al (cmol (+)⁻kg⁻¹)
<i>Kari</i> soils (AEU4)	Ambalapuzha	3.39	2.20	3.58	10.81	1.89
	Chathurthiakari	4.44	0.88	3.55	9.93	2.00
	Karumadi	3.83	3.92	7.52	15.65	3.93
<i>Pokkali</i> lands (AEU5)	Thathapilly	3.89	3.22	3.60	15.69	2.01
	Kaitharam	5.85	16.97	2.58	15.86	2.11
	Pannakkad	5.62	9.92	2.11	17.01	1.82
<i>Kole</i> lands (AEU6)	Arimbur	4.78	0.43	3.45	6.34	0.88
	Pullazhi	4.79	0.25	2.75	6.59	1.22
	Kololamba	4.56	0.39	2.44	7.92	1.84
<i>Kaipad</i> lands (AEU7)	Cherukunnu	5.15	11.62	1.59	9.38	0.01
	Ezhome	5.56	15.98	3.24	8.01	0.01
	Pattuvam	5.05	12.86	3.15	7.87	0.02
North central laterites (AEU 10)	Kottepadam	4.89	0.04	0.84	5.98	0.09
	Kaiparambu	4.56	0.12	1.28	5.81	0.08
	Mulamgunnathkavu	5.08	0.24	0.89	5.48	0.09

SM4. Exchangeable and acidic cations in soil samples (Refer Table 3)

AEU	Location	Exchangeable cations (cmol (+) kg ⁻¹)				Acidic cations (cmol (+) kg ⁻¹)				Percent Base Saturation (%)
		Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Fe ²⁺	Mn ²⁺	Al ³⁺	H ⁺	
<i>Kari</i> soils (AEU4)	Ambalapuzha	2.39	0.45	2.41	0.32	0.32	0.00	1.89	2.63	63.86
	Chathurthiakari	1.56	0.47	2.32	0.09	0.09	0.00	2.00	0.06	78.31
	Karumadi	3.57	0.31	2.07	0.72	0.72	0.01	3.93	0.65	67.42
<i>Pokkali</i> lands (AEU5)	Thathapilly	4.31	0.23	5.87	1.32	1.32	0.02	2.01	1.40	72.28
	Kaitharam	4.32	0.25	5.69	1.36	1.36	0.02	2.11	2.03	69.16
	Pannakkad	4.71	1.99	5.11	1.30	1.30	0.02	1.82	1.71	74.13
<i>Kole</i> lands (AEU6)	Arimbur	0.70	0.45	1.23	0.02	0.02	0.12	0.88	0.73	75.12
	Pullazhi	0.76	0.38	1.55	0.02	0.02	0.11	1.22	0.89	69.78
	Kololamba	1.10	0.49	1.80	0.02	0.02	0.04	1.84	0.18	74.02
<i>Kaipad</i> lands (AEU7)	Cherukunnu	4.44	0.90	3.23	0.02	0.02	0.03	0.01	0.10	98.31
	Ezhome	4.45	0.84	1.45	0.04	0.04	0.02	0.01	0.10	97.88
	Pattuvam	4.68	0.64	0.60	0.38	0.38	0.04	0.02	0.15	92.65
North central laterites (AEU 10)	Kottepadam	0.66	0.36	4.26	0.02	0.02	0.03	0.09	0.57	89.19
	Kaiparambu	0.63	0.35	4.07	0.01	0.01	0.02	0.08	0.70	87.54
	Mulamgunnathkavu	0.66	0.35	4.21	0.01	0.01	0.01	0.09	0.24	93.85

SM 5. Content of Fe in collected soils samples (Refer Table 4)

AEU	Location	0.1 N HCl Fe (Fe _{hc})	0.1M BaCl ₂ - Fe (Fe _{ex})	Total Fe (Fe _{tt})	Soil solution Fe (Fe _{sl})	CBD-Fe (Fe _{cb})
		mg kg ⁻¹				
<i>Kari</i> soils (AEU4)	Ambalapuzha	341.42	88.50	5600.00	20.17	5670.00
	Chathurthiakari	393.67	25.70	7180.00	17.15	6440.00
	Karumadi	878.50	200.00	5532.00	3.68	5060.00
<i>Pokkali</i> lands (AEU5)	Thathapilly	642.00	368.00	5285.00	52.49	3900.00
	Kaitharam	1346.83	380.00	9725.00	8.96	4675.00
	Pannakkad	632.67	363.30	9485.00.	8.55	4390.00
<i>Kole</i> lands (AEU6)	Arimbur	89.50	5.26	4605.50	0.09	14304.00
	Pullazhi	79.03	5.74	4700.00	0.03	14992.00
	Kololamba	88.71	4.38	5450.00	0.03	11392.00
<i>Kaipad</i> lands (AEU7)	Cherukunnu	385.33	4.89	6344.00	1.30	6335.00
	Ezhome	476.08	10.45	6865.21	4.06	6660.00
	Pattuvam	596.83	106.60	4995.00	31.09	7050.00
North central laterites (AEU10)	Kottepadam	93.71	4.56	8345.00	0.25	980.00
	Kaiparambu	105.57	3.04	3330.00	0.01	792.50
	Mulamgunnathkavu	49.95	3.85	2203.00	0.03	903.75
CBD : Citrate Bicarbonate Dithionate extractable Fe						

SM6. Iron fractions in soils of rice growing agro-ecological units of Kerala (Table 5)

AEU	Location	F _{wa}	F _{sp}	F _{as}	F _{mn}	F _{om}	F _{ai}	F _{ci}	F _{rs}
		mg kg ⁻¹							
AEU4	Ambalapuzha	420.50	8.88	124.96	1100.83	1191.66	1966.66	189.80	596.60
	Chathurthiakari	34.90	4.38	92.96	1591.66	1250.00	2952.50	336.66	916.90
	Karumadi	285.00	13.23	149.80	1495.00	1575.00	1410.00	81.80	522.10
AEU5	Thathapilly	951.66	9.61	212.66	1167.33	816.33	547.33	147.73	1432.30
	Kaitharam	187.83	7.08	281.83	2358.33	1458.33	2682.50	319.56	2429.50
	Pannakkad	143.73	6.35	273.83	2548.33	1758.33	2855.00	173.90	1725.50
AEU6	Arimbur	23.68	3.95	25.15	929.00	111.00	2475.83	827.33	209.55
	Pullazhi	24.45	4.73	21.70	687.66	666.00	1693.33	713.66	888.45
	Kololamba	23.01	3.98	25.20	813.33	575.00	393.33	380.00	3236.10
AEU7	Cherukunnu	23.43	3.16	86.31	395.00	1805.00	3623.33	171.33	236.40
	Ezhome	26.88	3.90	112.03	412.00	2143.33	3517.21	274.33	375.50
	Pattuvam	208.30	5.81	254.66	349.00	1210.00	1355.00	244.66	1367.50
AEU10	Kottepadam	20.71	3.23	35.75	547.66	414.33	885.66	300.63	6137.00
	Kaiparambu	21.28	2.80	33.71	497.00	291.36	684.33	135.03	1664.40
	Mulamkunnathkavu	20.58	2.73	31.95	288.30	217.43	496.66	190.20	955.13

Sequential fractions of Fe: F_{ws}, water-soluble and exchangeable; F_{sp}, specifically adsorbed Pb displaceable; F_{as}, acid-soluble; F_{mn}, manganese oxide-occluded; F_{om}, Organic matter occluded; F_{ai}, amorphous iron oxide-occluded; F_{ci}, crystalline iron oxide-occluded and F_{rs}, residual.

SM7. Forms of acidity of collected soil samples (Refer Table 6)

AEU	Location	A _{ex}	A _{et}	A _{ta}	A _{tp}	A _{ph}
		(cmol (+) kg ⁻¹ of soil)				
<i>Kari</i> soils (AEU4)	Ambalapuzha	4.52	14.63	4.50	17.00	12.47
	Chathurthiakari	1.94	14.08	2.98	16.58	14.63
	Karumadi	4.58	33.38	6.50	18.67	14.08
<i>Pokkali</i> lands (AEU5)	Thathapilly	3.41	20.37	4.80	36.79	33.38
	Kaitharam	0.09	22.98	1.44	20.46	20.37
	Pannakkad	0.11	44.40	1.50	23.10	22.98
<i>Kole</i> lands (AEU6)	Arimboor	0.15	44.19	2.06	44.55	44.40
	Pullazhi	0.33	42.39	2.15	51.97	44.19
	Kololamba	1.66	10.52	2.45	44.05	42.39
<i>Kaipad</i> lands (AEU7)	Cherukunnu	0.11	10.31	1.20	10.64	10.52
	Ezhome	0.11	8.80	1.36	10.43	10.31
	Pattuvam	0.17	68.40	0.83	8.97	8.80
North central laterites (AEU10)	Kottepadam	0.66	72.72	1.65	69.06	68.40
	Kaiparambu	0.78	65.93	1.36	73.50	72.72
	Mulamkunnathukavu	0.33	72.72	1.25	66.26	65.93

A_{ex}: Exchange acidity; A_{et} : Extractable acidity ; A_{ta} :Total acidity ; A_{tp} :Total potential acidity ; A_{ph} : pH dependent acidity

