This modified method differs from Durairaj method of rapid mechanical analysis, in using sodium hydroxide for complete dispersion of clay and in the estimation of both the fractions of sand instead of coarse sand alone. The use of the values of boath the fractions in the multiple regression equations give more precise value for clay. This method can be done only in laboratories whereas the device by Durairaj can be used by field workers.

Summary: A modified Durairaj method of rapid mechanical analysis for evaluating the soil separates was adopted, based upon the correlations of proportions of different separates depending upon soil type. The values were compared with International pipette method. The close agreement of the values by the two methods and especially of the textural classification proves the validity of this modified method for adoption in Soil Testing Laboratories and in Soil Survey work.

Acknowledgement: The authors are thankful to Dr. John Durairaj, Professor of Soil Science for his guidance and to Thiru S. Varadarajan, Agricultural Chemist and Associate Professor of Soil Science for his suggestions.

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https://doi.org/10.29321/MAJ.10.A03588

Chemical Transformations in Paddy Soils of Tamil Nadu in Relation to Paddy Growth and Yield

I. Progressive Variations in Chemical Composition of Soils

by

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Introduction: Rice being the staple diet of a large section of the population, a detailed study of the transformation of nitrogen and phosphorus in submerged paddy soils and of factors which might induce the increase of toxic principles to deleterious levels is bound to be of great importance in the economic use of nitrogen and phosphorus fertilisers under varying soil conditions.

Although benefits of green manuring have been observed in paddy soils, no systematic attempt has been made in paddy soils of Tamil Nadu to understand the behaviour of rice plant in relation to its peculiar chemical regime, which is totally different from that of normal upland soils. In the present investigation, it was proposed to investigate this aspect in detail.

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Materials and Methods ; Four representative paddy soils of Tamil Nadu from Aduthurai, Ambasamudram, Cuddalore and Tirurkuppam were selected for the present study. A pot culture experiment was laid out with paddy Co. 29. Three treatments were tried, the first being the departmental recommendation 30:30:15 (N: P_2O_5:K_2O) with basal dose of 5000 lb. green leaf per acre; second higher levels of nutrients 50 : 60 : 15 (N: P_2O_5: K_2O) with the same basal dose of green leaf and third, the same as treatment one, but with green leaf substituted by farm yard manure on the same nitrogen basis. These three treatments with four types of paddy soils formed 12 combinations which were replicated thrice.

Soil samples were collected periodically from dummy pots with treatment at intervals of 30 days for three rounds of analysis, post-harvest soil analysis formed the fourth round of analysis. The soil samples were analysed for ammoniacal, nitrate, available and total nitrogen, available phosphorus, aluminium, iron and calcium phosphates and total ferrous iron.

Ferrous iron was estimated following the method adopted by Daniels and associates (1961). Total nitrogen was estimated by the Kjeldahl method and the available nitrogen by alkaline permanganate method (Subbiah and Asija, 1956). Ammoniacal nitrogen was extracted from soil with 10% acidified sodium chloride and estimated colorimetrically after nesslerisation. Nitrate nitrogen was extracted from soils with nitrate extractant solution and estimated colorimetrically by phenol di-sulphonic acid method (Jackson, 1958). Fractionation of phosphorus was carried out by 0.5 N NH_4F, 0.1 N NaOH and 0.5 N H_2SO_4 treatments for aluminium, iron and calcium phosphates respectively and estimated colorimetrically using sulphomolybdic acid method (Jackson, 1958).

Results and Discussion : The data of the chemical constituent analysed in the present study are presented in Tables 1 to 3.

Progressive changes in the chemical constituents: Total Nitrogen: (Table 1) The content during the period of study ranged from 424 (Cuddalore) to 1054 (Aduthurai) ppm. From the data it could be seen that the total N did not differ between treatments or periods but the contents in Ambasamudram and Aduthurai soils were significantly higher than for the other soils.

Available Nitrogen: The data revealed that there was a gradual increase in the available nitrogen content of soils in all the three treatments up to 30 days and further rise or decrease up to 60 days was not appreciable but there was a decreasing trend in the final round of analysis representing the post-harvest stage. The increases in this content on water logging, with time, treatments and different soils were all statistically significant which was attributable to the fixation of N from atmosphere by blue green algae (De, 1936) which form as a scum on the surface of the water-logged soil. The other possible reason for this increase was the transformation of organic form of N to easily oxidizable form by the process of anaerobic mineralisation (Harad, 1961) through the action of soil bacteria. With regard to comparative efficacy of green manure and farm yard manure as organic source in treatments one and three, treatment one was found to be significantly more efficacious than treatment three in the matter of release of available N, indicating the superiority of green manure. The latter, according to Harrison and Aiyer (1916) favoured the development of an algal film which would lead to greater fixation of N from the atmosphere. Relationship between total and available N was worked out and positive and significant correlation co-efficient of 0.887 obtained.

Ammoniacal nitrogen (Table 1): There was a significant difference in ammoniacal N content between soils as seen in the table. Ambasamudram soil was found to be higher in this regard than the rest of the soils. The influence of different soils on the concentration of ammoniacal N was two fold, the first factor being the original ammoniacal content and the second, the cation exchange capacity of soil. The higher concentration of ammoniacal N in Ambasamudram soil was attributable to its low pH which was in accordance with the findings of Ponnamperuma (1955). The low concentration in Cuddalore soil was attributable to its poor clay content and consequent inability to fix the ammoniacal N which might have been lost either in soil solution or absorbed by plants. Results also indicated that the ammoniacal N contents on 0 and 30th day were significantly higher than on 60th day. The effect of soils on different periods was found to be significant but did not follow any regular trend.

Nitrate nitrogen (Table 1): It was observed that nitrate N content gradually decreased with time. The values ranged from 0 to 12.1 ppm. The low concentration of nitrate N was according to Russel (1951) due to rapid break-down of this form of N by microbial activity or absorption by crop.

The relationship of total, available and ammoniacal N comparing different periods studied in the investigation gave high correlation coefficients ranging from 0.840 to 0.990 (Table 4) indicating proportionate changes with periods. Such a close relationship between forms and between periods might be attributable to the uniform rate at which conditions prevailing in soils for microbial activities such as temperature and water content influenced these forms and their transformation.

Available phosphorus (Bray and Kurtz No. II - Table 2): The figures ranged from 2 ppm to 26 ppm. There was a gradual increase in this content

TABLE 1. *Changes in concentrations of nitrogen forms in soils with time (ppm - moisture-free basis)*

Treatments	DAYS FROM START 0				30				60				Post-harvest			
	Total N	Available N	Ammo-niacal N	Nitrate N	Total N	Available N	Ammo-niacal N	Nitrate N	Total N	Available N	Ammo-niacal N	Nitrate N	Total N	Available N	Ammo-niacal N	Nitrate N
S_1T_1	823	151	20.4	3.0	874	189	32.6	2.1	868	184	19.2	2.5	794	175	20.6	—
S_1T_2	877	169	21.1	2.1	937	209	34.6	1.7	968	187	17.7	0.9	825	171	18.5	—
S_1T_3	834	153	14.0	1.3	846	171	30.1	0.9	933	172	21.9	0.9	869	158	17.6	—
S_2T_1	926	171	58.8	7.3	937	206	49.0	5.3	988	177	33.3	5.7	808	172	22.7	1.7
S_2T_2	1010	188	71.1	5.3	1033	205	49.4	2.1	1054	181	36.6	1.3	935	174	16.6	2.1
S_2T_3	912	170	90.0	4.5	936	196	66.8	2.1	968	177	35.4	1.3	907	163	15.8	—
S_3T_1	482	105	25.5	3.3	509	120	25.4	4.1	497	136	21.1	4.9	481	103	13.3	—
S_3T_2	499	117	33.4	6.5	508	113	23.4	7.7	483	114	22.7	1.7	468	113	15.3	—
S_3T_3	467	102	22.7	5.3	496	102	19.8	12.1	524	109	14.9	2.9	424	98	14.1	—
S_4T_1	645	125	20.9	4.9	670	128	26.5	3.3	701	139	18.4	6.1	570	132	16.2	—
S_4T_2	688	128	21.7	3.1	727	137	25.2	2.9	718	145	22.5	3.7	598	121	15.0	—
S_4T_3	674	123	18.9	3.1	713	121	25.2	2.8	673	139	25.7	6.1	612	127	13.8	—

S_1=Aduthurai soil S_2=Ambasamudram soil S_3=Cuddalore soil S_4=Tirurkuppam soil

T_1=30 : 30 : 15 (N: P_2O_5 : K_2O) per acre as ammonium sulphate, superphosphate and potassium sulphate respectively and with a basal dressing of 5000 lb of green leaf

T_2=50 : 60 : 15 (N : P_2O_5 : K_2O) per acre with the same dose of green leaf

T_3=Same as T_1, but farm yard mannure substituted for green leaf on the same nitrogen basis

TABLE 2. *Phosphorus fractionation studies (ppm moisture-free basis)*

Treatment	Initial				30th day				60th day				Post-harvest			
	Aluminium phosphate	Iron phosphate	Calcium phosphate	Available phosphorus	Aluminium phosphate	Iron phosphate	Calcium phosphate	Available phosphorus	Aluminium phosphate	Iron phosphate	Calcium phosphate	Available phosphorus	Aluminium phosphate	Iron phosphate	Calcium phosphate	Available phosphorus
S_1T_1	20.3	87.4	66.1	2.0	16.9	86.8	72.0	5.0	40.1	111.0	64.1	9.0	16.8	107.2	65.2	3.0
S_1T_2	18.1	94.5	70.1	5.0	19.4	103.6	79.9	4.0	32.4	152.0	71.3	3.0	23.2	129.0	52.6	3.0
S_1T_3	17.1	85.1	68.1	4.0	10.6	84.8	89.0	4.0	34.4	129.0	47.3	9.0	23.1	119.9	48.4	5.0
S_2T_1	17.3	99.5	67.0	3.0	12.2	105.4	53.2	3.0	24.4	148.4	59.0	4.0	24.3	115.3	24.3	4.0
S_2T_2	17.5	103.6	52.8	4.0	10.1	109.1	52.3	3.0	20.3	166.8	46.8	4.4	36.4	153.8	32.4	5.0
S_2T_3	16.3	102.3	69.2	3.0	16.2	109.3	50.2	3.0	18.3	132.1	38.7	7.0	30.4	121.5	24.3	4.4
S_3T_1	18.2	50.6	50.6	5.0	10.1	62.6	62.6	7.0	18.3	50.7	85.2	13.0	33.1	24.3	64.7	5.6
S_3T_2	15.3	79.4	59.1	6.0	10.1	60.0	74.7	8.0	26.4	28.4	60.9	14.0	26.3	18.2	86.9	6.0
S_3T_3	15.1	56.6	66.7	4.4	10.1	74.8	54.6	5.0	18.2	24.3	44.6	9.0	30.3	16.0	84.4	8.0
S_4T_1	18.4	57.5	53.7	5.0	22.4	40.8	71.3	8.0	36.8	59.3	47.0	24.0	38.7	32.6	46.8	5.0
S_4T_2	20.6	46.1	51.2	8.0	28.5	40.7	81.5	10.0	49.2	49.2	100.6	26.0	36.6	56.9	38.6	6.0
S_4T_3	20.5	71.7	73.4	4.0	32.6	34.6	89.6	8.0	45.0	47.0	47.0	24.0	40.7	52.9	36.6	7.0

TABLE 3. *Changes in Concentration of total ferrous iron in soils with time (Ferrous Fe in ppm, moisture-free basis)*

Treatments	Day from start			
	0	30	60	85
S_1T_1	11	3807	6705	11050
S_1T_2	12	3387	5855	7852
S_1T_3	8	2632	4774	7249
S_2T_1	36	1401	1638	1755
S_2T_2	41	988	1453	1555
S_2T_3	28	946	1590	1807
S_3T_1	8	618	929	1111
S_3T_2	9	687	852	1140
S_3T_3	8	462	632	980
S_4T_1	36	1342	1719	1769
S_4T_2	33	1286	1657	2101
S_4T_3	20	1393	1434	1882

TABLE 4. *Correlation coefficients for different relationships*

Relationship	Correlation co-efficient
Relationships between soil constituents:	
a) Total N *Vs.* Available N	0.887***
Relationships between soil constituents studied at different periods:	
a) Total N Initial *Vs.* 30th day	0.998***
b) Total N 30th day *Vs.* Final	0.977***
c) Available N 30th day *Vs.* Final	0.961***
d) Available N Initial *Vs.* 30th day	0.919***
e) Ammoniacal N Initial *Vs.* 30th day	0.843***
f) Iron Phosphate Initial *Vs.* 60th day	0.850***

***Significant at 0.1% level

up to 60th day indicating the increasing trend of available phosphorus. The increase in solubility of phosphorus might be attributed to the reduction of ferric to ferrous phosphate. Both green manure and farm yard manure as organic sources were found to be not significant with regard to release of available phosphorus in water-logged soils. This finding was in line with those reviewed by Ponnamperuma (1955) which indicated that complexing components of organic matter had ability to displace phosphate from clays and oxides of iron and alumina, this being marked only in well drained soils and there being no possibility of release of phosphates in submerged soils.

Phosphates fractions (Table 2): Though the variations in values of aluminium and iron phosphate fractions showed an increasing trend up to 60 days, the variations in these forms of phosphorus were found to have no relationship among themselves and the decrease or increase was neither consistent nor appreciable. This was presumably due to the frequent interconversions between forms of phosphorus during water-logging. The iron phosphate at the initial stage was highly correlated with the values of 60th day indicating the proportionate increase with time. This finding was similar to that of McGreger (1953) and Mack and Barber (1961).

Ferrous Iron (Table 3): The data revealed that there was marked reduction of ferric iron to ferrous iron proceeded at a high rate and the increase in concentration with time was statistically significant. Among soils, Aduthurai was found to have significantly more of this content, with a mean value of 4445 ppm than other soils. This could be attributed to the high sesquioxidic nature and to the impeded drainage due to its high clay consistency. The reduction of iron, in the case of treatment with green leaf manure was found to be statistically significant and in line with the findings of Rao (1956).

Summary: Four typical paddy soils from Aduthurai, Ambasamudram, Cuddalore and Tirurkuppam were studied with Co.29 paddy as a test crop under pot culture and with three treatments, the first being the departmental recommendation 30:30:15 (N: P_2O_5 : K_2O), the second at higher levels of nutrients 50:60:15 (N: P_2O_5 : K_2O) and the third, the same as one but with farm yard manure instead of green manure for the basal dressing.

Mineralisation of N increased with time of water-logging in all the soils as revealed by the available N content. The increase was markedly proportionate with time and the relationship between available and total N was very high. Green leaf manure was observed to favour the mineralisation. The available phosphorus (Bray II) followed the same trend as available N but neither green manure nor farm yard manure favoured the mineralisation. The increase in alkali-soluble phosphorus (iron phosphate) with time was appreciable and in general it was found that the various forms of inorganic phosphates were interconvertible during water-logging. The reduction of iron was most striking on water-logging, it being seen prominently in the case of Aduthurai soil. This was attributed to its high sesquioxidic nature and to the impeded drainage due to its high clay consistency. The green leaf manure was found to increase the reduction process significantly over farm yard manure.

Acknowledgements: Thanks are due to the University of Madras for granting permission to publish the dissertation work and to the Government of Tamil Nadu for granting merit scholarship to the first author during the course of this investigation.

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Soil Fertility Studies in Tamil Nadu Using Radio-tracer Technique-III. Utilisation of Superphosphate Applied to Paddy through a Preceding Green Manure Crop

By

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Introduction : Radio-tracer studies have shown that only 10—20% of the phosphate applied as fertilizer is utilised by crops. With reference to paddy the application of phosphate through a preceding green manure crop has been considered of some value. Sen and Sunder Rao (1952) reported that in Bihar, phosphate manuring of *daincha* for green manuring paddy showed marked increase in yields of both green manure and paddy crop. In Mysore, sunnhemp in conjunction with superphosphate gave marked increases in yields of both green manure and succeeding paddy. Relwani and Ganguli (1959) working on Punjab soils have reported no beneficial effects due to application of phosphate through a green manure for paddy. Work done at Coimbatore during 1954-57 (Anon, 1954-55, 1955-56, 1956-57) did not show any beneficial

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