

Influence of Phosphatic manuring on the available Nitrogen, pH and Organic Carbon of the soil*

by

U. S. SREE RAMULU¹ AND A. MARIAKULANDAI²

Synopsis: The results of the study undertaken to assess the variation in the soil pH, available N and organic carbon content, due to the addition of phosphates in the form of inorganic superphosphate or as farm yard manure, and their combinations in ratios from 1:1 to 1:3 organic P to inorganic P and vice versa are discussed in this paper.

Introduction: The study was undertaken with the view to assess the influence of super phosphate and farm yard manure in equal phosphorus level on the available nitrogen, pH and organic carbon content of the soil. The Paddy Specialist and the Government Agricultural Chemist (1944) in their review on the manurial trials conducted between 1930-'40 on all crops in Madras State reported significant increase in the yield of *ragi* when superphosphate was applied alone or in combination with cattle manure, the latter recording higher yields in the permanent manurial plots at Coimbatore. Superiority of the phosphorus in farm yard manure over the chemical forms of phosphorus had been attributed to various indirect effects by Salter and Schollenberger (1939), Dalton and Russel (1952). But studies at Cornell University in which radio-active phosphorus was used, have shown relatively high availability of farm yard manure phosphorus to plants (quoted by Stanford and Pierre, 1953). McAuliffe and Bradfield (1955) found that the two sources of phosphorus were the same in the first 30 days while the availability of phosphorus in the organic source exceeds that of superphosphate afterwards.

In the study on the influence of phosphorus fertilisation on the absorption of the other nutrients, Chandrasekharan *et al.* (1953) found depression in the nitrogen content with increasing phosphorus application in wheat. In addition to influencing the composition of plants, the application of phosphatic manures and fertilisers influence the available nitrogen in the soil and also the organic carbon content of the soil. Black and Goring and others pointed out that the content of organic phosphates in soils was positively correlated with the organic carbon and nitrogen in soil. Thompson *et al.* (1954) had given an equation showing the relationship between organic phosphorus, organic carbon and pH.

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1. Assistant Lecturer in Chemistry, Agricultural College, Coimbatore-3. Present Address: 3446, Avacado Street, Riverside, California.
2. Government Agricultural Chemist and Professor of Soil Science, Coimbatore-3. Presently working as Professor of Agronomy, Post-Graduate Training Centre, Coimbatore-3.

Sauerlandt and Grietzner (1953) recorded a significant increase in organic carbon in the autumn and winter months and showed fluctuation of organic carbon content to exist in fallow soils.

In view of the conflicting evidence regarding the superiority of chemical fertilisers and organic manures one over the other and their influence on the composition of soils at various stages of crop growth, the present investigation was taken up.

Materials and methods: The treatments were as follows:

Treatment No. 1	Control—No manure.		
Treatments No. 2-5	Farm yard manure to supply 10 lb., 20 lb., 30 lb. and 40 lb. P_2O_5 /acre respectively.		
Treatments No. 6-9	Superphosphate to supply 10 lb., 20 lb., 30 lb. and 40 lb. P_2O_5 /acre respectively.		
Treatments No. 10-15	Combination of farm yard manure and superphosphate as given below to supply 20, 30 and 40 lb. of P_2O_5 partly as organic and partly inorganic P_2O_5 .		
Treatment No.	Farm yard manure to supply		Superphosphate to supply
10	10 lb. P_2O_5 /acre	+	10 lb. P_2O_5 /acre
11	10 lb. "	+	20 lb. "
12	10 lb. "	+	30 lb. "
13	20 lb. "	+	10 lb. "
14	20 lb. "	+	20 lb. "
15	30 lb. "	+	10 lb. "

The treatments were adopted with a view to have one level above and one level below the state manurial recommendations of 20 lb. P_2O_5 per acre for the *ragi* crop. The *ragi* varieties tried were Co. 1 which is a short duration variety and Co. 7 which is a long duration variety.

The available nitrogen was estimated by the alkaline permanganate method: pH by the electrometric method and the organic carbon by the Walkley and Black Method.

Results of the Experiments: The results of the experiments are presented in tables 2, 3 and 4 showing the periodical variations in available nitrogen, organic carbon and pH, for the different treatments in comparison with the fallow plots and the Co. 1, Co. 7 *ragi* plots. It will be seen from the tables that the following conclusions could be drawn.

Soil pH: There was no variations in the soil pH due to the treatments and also in the cropped and uncropped plots.

TABLE I
Mean Yield Data (In Pounds per acre)

Treat- ment No.	Amount of phosphorus (P ₂ O ₅) supplied as		Co. 1 Ragi		Co. 7 Ragi		
	Farm Yard manure	Super- phosphate	Grain	Straw	Grain	Straw	
1.	CONTROL		1004	6606	1403	5600	
2.	10 lb.	...	1037	6785	1459	5812	
3.	20 lb.	...	1058	6874	1543	5714	
4.	30 lb.	...	1121	7210	1637	6020	
5.	40 lb.	...	1143	7242	1659	6040	
6.	...	10 lb.	1070	6799	1482	5700	
7.	...	20 lb.	1140	6894	1546	5814	
8.	...	30 lb.	1159	7459	1664	5929	
9.	...	40 lb.	1191	7481	1698	6014	
10.	10 lb.	+	10 lb.	1120	6831	1600	5829
11.	10 lb.	+	20 lb.	1179	7324	1658	5976
12.	10 lb.	+	30 lb.	1209	7541	1699	6100
13.	20 lb.	+	10 lb.	1194	7201	1642	5924
14.	20 lb.	+	20 lb.	1221	7407	1679	5944
15.	30 lb.	+	10 lb.	1195	7328	1674	5829

Available nitrogen: The data in table 3 would reveal that in the cropped field the maximum availability of nitrogen is in the second week of the crop growth, while the variation in the fallow plots is gradual and does not reach the peak in the second week.

Again, by comparing the farm yard manure treated plots with the superphosphate treated plots, it will be clear that the availability of nitrogen is higher in the farm yard manure plots during the initial stages of the crop growth. But when farm yard manure and superphosphate were combined the availability of nitrogen is maintained at the same level without showing any initial or final variations, as in the case of single treatments, with farm yard manure and superphosphate individually.

Organic carbon: The organic carbon content as seen from the data (table 4) reveals that the cropped plots though low in this factor in the earlier stages ultimately improved as the season advanced and finally showed more organic carbon than the fallow plots. The organic carbon in the farm yard manure treated plots was more than in the superphosphate plots. The combination of the farm yard manure and superphosphate gave an organic carbon content which was intermediate between individually treated farm yard manure and superphosphate plots.

TABLE 2
Variations in the pH of soil during crop growth

S. No.	Amount of phosphorus (P ₂ O ₅) supplied as		Date															
	Farm Yard manure	Super-phosphate	20-4-1959	5-5-1959	20-5-1959	5-6-1959	20-6-1959	20-4-1959	5-5-1959	20-5-1959	5-6-1959	20-6-1959	20-4-1959	5-5-1959	20-5-1959	5-6-1959	20-6-1959	
			Co. 1 Ragi				Co. 7 Ragi				Fallow							
1.	CONTROL		8.1	8.0	8.1	8.2	8.2	8.1	8.0	8.1	8.2	8.2	8.0	8.1	8.2	8.2	8.2	8.2
2.	10 lb.	...	8.0	8.1	8.0	8.2	8.2	8.0	8.1	8.0	8.2	8.2	8.0	8.1	8.1	8.2	8.2	8.3
3.	20 lb.	...	8.2	8.2	8.0	8.1	8.2	8.1	8.0	8.0	8.2	8.2	8.0	8.0	8.0	8.0	8.1	8.1
4.	30 lb.	...	8.0	8.1	8.2	8.2	8.1	8.0	8.1	8.2	8.1	8.1	8.1	8.1	8.1	8.2	8.3	8.2
5.	40 lb.	...	8.1	8.1	8.2	8.2	8.2	8.1	8.1	8.2	8.2	8.2	8.1	8.2	8.1	8.2	8.1	8.2
6.	...	10 lb.	8.0	8.0	8.1	8.1	8.1	8.1	8.0	8.1	8.2	8.2	8.0	8.1	8.1	8.2	8.2	8.0
7.	...	20 lb.	8.1	8.1	8.0	8.1	8.2	8.2	8.1	8.0	8.2	8.2	8.1	8.1	8.2	8.2	8.2	8.0
8.	...	30 lb.	8.1	8.2	8.0	8.1	8.2	8.1	8.2	8.1	8.2	8.2	8.2	8.1	8.1	8.2	8.2	8.1
9.	...	40 lb.	8.10	8.1	8.2	8.2	8.3	8.0	8.1	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.1	8.1
10.	10 lb.	+	8.1	8.2	8.1	8.3	8.3	8.1	8.2	8.1	8.2	8.3	8.1	8.2	8.0	8.2	8.0	8.2
11.	10 lb.	+	8.1	8.2	8.1	8.2	8.3	8.1	8.2	8.1	8.1	8.1	8.2	8.3	8.3	8.3	8.5	8.4
12.	10 lb.	+	8.1	8.0	8.2	8.2	8.2	8.1	8.0	8.1	8.1	8.2	8.0	8.1	8.1	8.1	8.1	8.2
13.	10 lb.	+	8.0	8.0	8.1	8.1	8.1	8.0	8.1	8.2	8.2	8.2	8.0	8.1	8.0	8.1	8.0	8.1
14.	20 lb.	+	8.1	8.2	8.0	8.2	8.2	8.1	8.2	8.0	8.1	8.2	8.1	8.2	8.2	8.2	8.2	8.2
15.	30 lb.	+	8.1	8.1	8.0	8.1	8.2	8.1	8.1	8.0	8.2	8.2	8.0	8.1	8.0	8.1	8.1	8.1

TABLE 3

Variations in the available nitrogen status of the soil during crop growth (in pounds per acre)

S. No.	Amount of phosphorus (P ₂ O ₅) supplied as		Co. 1 Ragi				Co. 7 Ragi				Fallow								
	Farm Yard manure	Super-phosphate	20-4-1959	5-5-1959	20-5-1959	20-6-1959	20-4-1959	5-5-1959	20-5-1959	20-6-1959	20-4-1959	5-5-1959	20-5-1959	20-6-1959					
1.	CONTROL		196	238	182	182	210	182	196	224	196	224	196	224	210	245	252	196	138
2.	10 lb.	...	210	217	238	168	196	196	315	196	224	224	224	182	182	259	252	268	196
3.	20 lb.	...	224	252	224	196	196	210	252	210	196	210	252	231	238	231	238	182	182
4.	30 lb.	...	238	196	196	182	210	182	280	210	182	154	227	259	252	287	252	308	182
5.	40 lb.	...	238	343	210	140	196	168	196	210	196	154	210	210	287	322	280	308	168
6.	...	10 lb.	224	210	196	182	210	182	224	182	196	168	224	224	322	280	252	224	168
7.	...	20 lb.	210	196	182	210	210	182	182	196	196	196	224	224	224	224	252	224	168
8.	...	30 lb.	224	224	238	196	168	182	280	168	224	196	168	168	238	238	238	210	196
9.	...	40 lb.	182	224	210	182	210	196	294	196	210	196	224	224	224	224	224	224	168
10.	10 lb.	+	210	210	210	210	154	196	224	182	224	210	182	182	238	238	238	210	140
11.	10 lb.	+	196	224	210	182	182	210	266	182	196	196	214	252	224	252	224	210	210
12.	10 lb.	+	210	224	196	196	196	196	252	252	196	210	182	245	224	224	224	196	168
13.	20 lb.	+	196	210	252	192	224	196	196	238	182	196	196	252	238	252	238	224	140
14.	20 lb.	+	196	224	238	154	210	182	210	238	224	182	168	238	238	238	238	196	168
15.	30 lb.	+	182	238	252	196	224	168	231	196	196	210	266	262	224	262	224	210	154

TABLE 4

Variations in the organic carbon content of the soils during crop growth (Percentage of organic carbon content)

No.	Amount of Phosphorus (P ₂ O ₅) supplied as Farm yard manure + Super- phosphate	Date														
		20-4-59	5-5-59	20-5-59	5-6-59	20-6-59	20-4-59	5-5-59	20-5-59	5-6-59	20-6-59	24-7-59	5-8-59	20-8-59	5-9-59	20-9-59
		Co. 1 Ragi					Co. 7 Ragi					Fallow				
1.	CONTROL	0.495	0.555	0.645	0.705	0.690	0.435	0.615	0.540	0.720	0.618	0.465	0.435	0.435	0.540	0.600
2.	10 lb.	0.450	0.650	0.510	0.645	0.600	0.480	0.570	0.585	0.615	0.660	0.480	0.480	0.465	0.510	0.615
3.	20 lb.	0.410	0.675	0.525	0.655	0.810	0.570	0.615	0.585	0.765	0.648	0.480	0.465	0.405	0.630	0.660
4.	30 lb.	0.780	0.720	0.690	0.615	0.750	0.585	0.675	0.585	0.675	0.570	0.525	0.585	0.510	0.600	0.795
5.	40 lb.	0.540	0.630	0.675	0.720	0.600	0.570	0.675	0.495	0.645	0.810	0.600	0.630	0.465	0.600	0.855
6.	...	0.435	0.495	0.465	0.510	0.570	0.595	0.630	0.645	0.600	0.390	0.465	0.480	0.510	0.540	0.800
7.	...	0.540	0.540	0.510	0.690	0.675	0.375	0.465	0.630	0.495	0.460	0.435	0.450	0.390	0.525	0.645
8.	...	0.480	0.570	0.465	0.600	0.630	0.525	0.465	0.615	0.585	0.588	0.525	0.595	0.420	0.540	0.630
9.	...	0.435	0.630	0.495	0.630	0.705	0.360	0.465	0.570	0.650	0.480	0.435	0.435	0.480	0.510	0.650
10.	10 lb. +	0.455	0.585	0.510	0.666	0.870	0.540	0.480	0.585	0.465	0.630	0.465	0.600	0.465	0.495	0.720
11.	10 lb. +	0.555	0.660	0.465	0.645	0.855	0.480	0.540	0.600	0.615	0.735	0.600	0.510	0.540	0.540	0.735
12.	10 lb. +	0.495	0.570	0.495	0.705	0.690	0.495	0.525	0.630	0.615	0.675	0.480	0.525	0.570	0.525	0.660
13.	20 lb. +	0.480	0.585	0.525	0.675	0.630	0.525	0.630	0.675	0.735	0.675	0.615	0.630	0.615	0.585	0.765
14.	20 lb. +	0.480	0.555	0.480	0.570	0.450	0.525	0.585	0.585	0.765	0.555	0.480	0.495	0.525	0.525	0.735
15.	30 lb. +	0.540	0.570	0.525	0.600	0.525	0.435	0.660	0.610	0.675	0.795	0.480	0.630	0.640	0.600	0.750

Discussion and Conclusions: It is clear from the study that variations in the form and level of P_2O_5 , as supplied through farm yard manure and superphosphate does not affect the pH to a great extent. The available nitrogen, however, is well influenced by the presence of farm yard manure at earlier stages and by the super in the later stages of crop growth and hence a combination of these two as in combined treatments 10 to 15 (table 3) would give a good supply of available nitrogen for maximum crop growth. These conclusions were borne out also from the fact that combinations gave a better yield of grain and straw (table 1). In regard to organic carbon, Sauerlandt and Graetgner (1953) had shown that fluctuations are possible even during the crop growth in the organic carbon content of the soil. In this study also, throughout the season, except in the treatment with 10 lb. P_2O_5 , the superphosphate treated plots, had lower organic carbon content, than the farm yard manure treated plots. The difference between the organic carbon content of the plots receiving farm yard manure and that receiving superphosphate, widened as the season advanced and was in favour of the farm yard manure plot.

The organic carbon content during the crop growth was less than the fallow plots in the earlier stages but the position was reversed in the later stages of the seasons, possibly because of the crop contributing to the organic carbon content through dead roots, leaves, etc. in the cropped fields. The data also clearly brings out the fact that a combination of the farm yard manure and superphosphate would give an intermediary organic carbon content between farm yard manure plots and superphosphate plots. These intermediary organic carbon content with the steady available nitrogen as already indicated for the combined plots receiving farm yard manure and superphosphate would be the optimum for good crop yield. This has been shown to be true by the yields recorded for the different treatments.

Summary: The results of the experiment indicated that during the growth of the crop, the organic carbon content of the soil fluctuates showing a minimum in the 15th to 40th day period and exhibits an increase afterwards. The phosphorus applications also influence the available nitrogen but not the pH. The available nitrogen is influenced by the presence of farm yard manure in the early stages and super in the later stages and hence the combination of these two has given a better yield of grain and straw in this experiment.

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AWARD OF M. Sc. DEGREE

Sri V. Ramakrishnan, Assistant Botanist, Agricultural College & Research Institute, Coimbatore has been awarded the M. Sc. Degree by the University of Madras for his thesis "Comparative anatomy of certain South Indian genera of Vitaceae Lindl." Our hearty congratulations to him.