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Nitrogen and Phosphorus Relationship in Urban Composts *

by

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Synopsis: Urban compost samples received from the local bodies of the Madras State during the years 1961–62 and 1962–63 were analysed for total nitrogen and total phosphoric acid contents and a relationship has been worked out between them. The findings are discussed in this paper.

Introduction: The quality of compost manure is judged by its total nitrogen and phosphoric acid contents. A large quantity of urban compost estimated about 57,000 tons per year is at present produced by the municipalities and panchayats of the Madras State from street sweepings, market and slaughter-house wastes and night-soil. Night-soil is rich in nitrogen, phosphorus, potassium and calcium (Acharya 1949) and hence it is used as a 'starter' for the conversion of other refuse materials like garbage into organic manure by a process of vigorous microbial decomposition. As the nitrogen and phosphorus contents of night-soil are in the form of phospho-proteins and night-soil is an important constituent of urban compost, a positive correlation could be expected between nitrogen and phosphoric acid contents of urban compost manure. Black and Goring (1953) have reported that the carbon, nitrogen and phosphorus contents of organic materials are positively correlated. In order to test whether such a correlation exists in the case of urban compost, a large number of samples were obtained from composts prepared by the municipalities and panchayats of the Madras State during the years 1961–62 and 1962–63 and were analysed for their total nitrogen and phosphorus contents. A summary of the above data is presented in this paper.

Review of literature: Acharya (1939) evolved the Bangalore method of composting which with suitable modifications is adopted by the local bodies of the Madras State. A review of literature relating to the scientific aspects of the above process (Acharya 1940, 1949; Acharya, *et al.* 1945, 1946-a, 1946-b; Ghosh, 1959) shows that no systematic study has so far been made on the relation between total nitrogen and total phosphoric acid contents of urban compost. Hence it is believed that the data presented in this paper may prove to be a useful contribution to the subject.

Materials and Methods: In the Bangalore method of composting adopted by the local bodies, rectangular piles of garbage measuring 40' x 11' at the base were built up to a height of 3½' by depositing alternate layers of 9" thickness rubbish and 3" thickness night-soil overground. The piles were provided with extra moisture from sullage water when necessary. The rubbish was allowed to decompose for a period of about six months after which the

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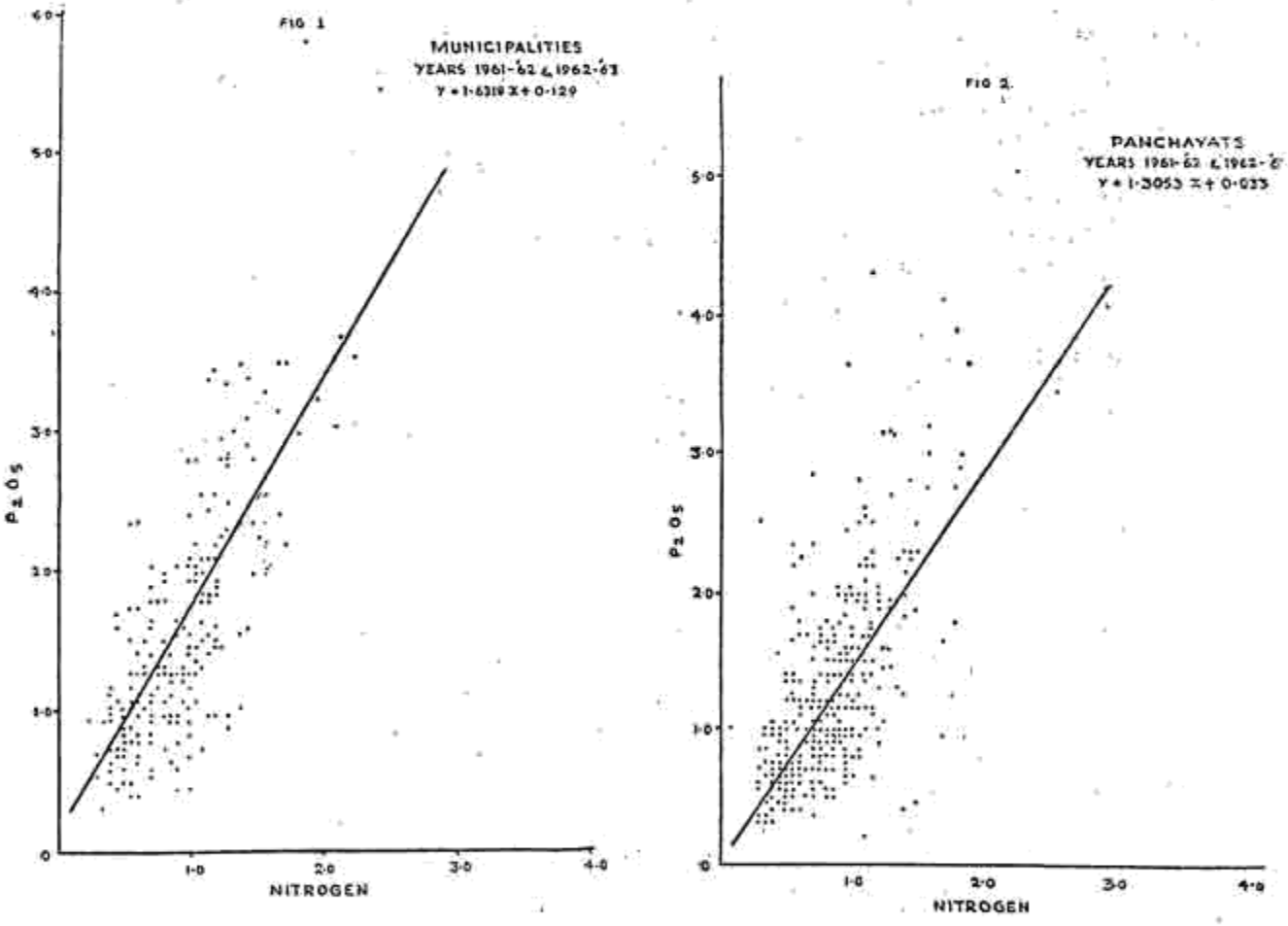
compost was removed for application to the field as manure. On an average, about 20 tons of compost were obtained from each compost heap. Compost samples were drawn from several points in a heap and a composite sample was prepared representative of 3 or 4 heaps, and this composite sample was taken to represent the urban compost prepared at that centre. Similar composite samples of compost were obtained from a large number of municipalities and panchayats operating the compost scheme in the Madras State. When the compost samples arrived in the laboratory, they were moistened with dilute acetic acid in order to prevent further microbial decomposition, then air-dried, powdered and passed through 1 mm mesh sieve before taking them up for chemical analysis. Total nitrogen and total phosphoric acid contents of the compost samples were determined by the A. O. A. C. methods (A. O. A. C. 1962).



Results and discussion: The data obtained for the total nitrogen and total phosphoric acid contents of urban compost samples are shown graphically in the scatter diagrams given in Fig. (1) for composts prepared by municipalities and in Fig. (2) for composts prepard by the panchayats in Madras State. The correlation coefficient between nitrogen and phosphoric acid for the whole state is 0·732 for municipality composts and 0·659 for panchayat composts and both are significant at P=0·001. The regression coefficient for the whole state works out to 1·632 in the case of municipal compost and 1·3053 in the case of panchayat compost. The steeper slope of the regression line and the

higher correlation coefficient between nitrogen and phosphoric acid in the case of municipal compost as compared to panchayat compost is probably due to the fact that the collection of night-soil is more efficient and its addition to the compost is in higher proportion in municipal areas as compared to panchayats. Since night-soil is much richer in nitrogen and phosphoric acid than other garbages (Acharya 1949), the proportion of night-soil added to compost influences to a great extent the correlation ratio between nitrogen and phosphoric acid in the compost. It is also possible that the larger quantity of meat-stall and slaughter-house wastes found in municipal compost might contribute to its higher phosphate content, as compared to panchayat compost.

In order to study the corrlation in more detail, the data for the whole state were subdivided into groups representing each district and the average values for nitrogen and phosphoric acid of the urban compost prepared by municipalities and panchayats in each district were worked out. These data are presented in Table I. The figures given in the above table again confirm the fact that municipal compost is in general richer in phosphoric acid than panchayat compost. This conclusion is in accord with the analytical data for the earlier years 1956–63 studied by Krishnamurthy and Samboornaraman (1964).

TABLE I.

Data on Nitrogen and P_2O_5 contents of urban compost expressed on oven dry basis in percentages

S. No.	District	Municipalities				Town Panchayats			
		1961–'62		1962–'63		1961–'62		1962–'63	
		Nitrogen (average)	P_2O_5 (average)	Nitrogen (average)	P_2O_5 (average)	Nitrogen (average)	P_2O_5 (average)	Nitrogen (average)	P_2O_5 (average)
1.	Coimbatore ...	1·25	2·08	0·95	1·84	0·95	1·23	0·89	1·37
2.	Salem ...	0·86	1·23	0·67	1·25	0·65	0·91	0·73	1·21
3.	Madurai ...	0·84	1·53	1·03	1·75	0·74	1·11	0·84	1·31
4.	Ramnad ...	0·71	1·19	0·84	1·59	0·63	1·43	0·90	1·60
5.	Tirunelveli ...	1·10	2·04	1·36	2·48	0·98	1·42	0·81	1·13
6.	Kanyakumari ...	1·28	2·25	1·10	1·78	Nil	Nil	Nil	Nil
7.	Tiruchirapalli ...	0·89	1·31	0·92	1·51	1·03	1·44	0·87	1·39
8.	Tanjore ...	0·72	1·52	0·83	1·46	0·64	0·89	0·69	1·20
9.	North Arcot ...	0·97	1·97	0·98	1·44	0 93	1·62	1·05	1·53
10.	South Arcot ...	0·87	1·34	0 69	1·02	0·72	1·53	0·81	1·41
11.	Chingleput ...	0·83	1·82	0·80	1·57	0·94	1·40	1·03	1·29
12.	Nilgiris ...	1·07	1·13	1·19	1·40	1·33	1·65	1·12	1·31

The primary analytical data for all the samples belonging to each district (municipalities or panchayats) were statistically analysed separately for each group and the statistical results for each district are presented in table II and III. In the case of some of the smaller districts which did not provide sufficient body of data for satisfactory statistical treatment, these areas have been tagged to the adjoining bigger areas.

TABLE II.

Statistical Data for the Relationship between total Nitrogen and total Phosphoric acid contents of compost of Municipalities.

S. No.	District	Correlation Coefficient	Regression Coefficient	Regression equation
I				
1.	Coimbatore ...	0·615**	1·974	Y=1·9742x−0·1624
2.	Salem & Nilgiris ...	−0·329	0·222	Y=1·5480−0·2215x
3.	Madurai ...	0·609**	1·227	Y=1·227 x+0·4914
4.	Ramnad ...	0·599***	1·319	Y=1·3194x−0·466
5.	Tirunelveli and Kanyakumari ...	0·549**	0·999	Y=0·9843+0·9994x
6.	Tiruchirapalli ...	0·791***	1·779	Y=1·779 x−0·1685
7.	Tanjore ...	0·660***	1·774	Y=1·774 x+0·1110
8.	North Arcot and South Arcot ...	0·903***	2·072	Y=2·0715x−0·353
9.	Chiugleput ...	0·710***	2·212	Y=2·212 x−0·091
II				
1.	Total for Madras State	0·732***	1·632	Y=1·6319x+0·129

** Significant at P=0·01
*** Significant at P=0·001
Others not significant even at 0·1.

TABLE III.

Statistical Data for the Relationship between total Nitrogen and total Phosphoric acid contents of composts of Town Panchayats.

S. No.	District	Correlation Coefficient	Regression Coefficient	Regression equation
1.	Coimbatore ...	0·864***	2·081	Y=2·0806x−0·5236
2.	Salem & Nilgiris ...	0·668***	0·9242	Y=0·9242x+0·4154
3.	Madurai ...	0·628***	1·2443	Y=1·7831x+0·2278
4.	Ramnad ...	0·771***	1·7831	Y=1·7831x+0·1725
5.	Tirunelveli and Kanyakumari ...	0·559***	0·9139	Y=0·9139x+0·4531
6.	Tiruchirapalli ...	0·700***	1·2467	Y=1·2467x+0·2606
7.	Tanjore ...	0·814***	1·9184	Y=1·9184x−0·2079
8.	North Arcot and South Arcot ...	0·629***	1·1742	Y=2·0715x−0·353
9.	Chingleput ...	0·112	0·2384	Y=1·2258+0·1116x
II				
1.	Total for Madras State	0·659***	1·3053	Y=1·3053x+0·033

*** Significant at P=0·001
Others not significant even at P=0·1

A study of the data presented in Tables II and III reveal that:—

(i) In most of the municipal and panchayat areas, there is a significant correlation between the nitrogen and phosphoric acid contents of urban compost. The exceptions are the municipal compost prepared in Salem and Nilgiris and the panchayat compost prepared in Chingleput district. Since Nilgiris is a mountainous district it is probable that the collection of night-soil might not be so complete as in the plains.

(ii) A study of the regression lines for the municipalities and panchayats shows that the same pattern does not hold good for all the areas, municipalities of Salem and Nilgiris districts and the Panchayats of Chingleput district showing a different pattern from the others.

(iii) The regression coefficients obtained for the total nitrogen and phosphoric acid contents of the composts of municipalities and panchayats in respect of the districts of the Madras State fall into two groups, viz., (a) one group having a regression coefficient of about 1, and (b) the other group having a regression coefficient of about 2. Under the former group fall the municipalities of Madurai, Ramnad, Tirunelvely and Kanyakumari, and the panchayats of Salem and Nilgiris, Madurai, Tirunelvely and Kanyakumari, Tiruchirapalli, North Arcot and South Arcot districts and under the latter group are the municipalities of Coimbatore, Tiruchirapalli, Thanjavoor, South Arcot, North Arcot and Chingleput districts and panchayats of Coimbatore, Ramnad and Thanjavoor districts.

The present study therefore reveals that there is a significant relationship between the levels of nitrogen and phosphoric acid in urban compost prepared by the municipalities and town panchayats of Madras State. This relationship is possibly due to the similarity of conditions in most parts of the State under which night-soil is collected and utilised in compost preparation. It would be interesting whether a similar, close relationship exists between the nitrogen and phosphoric acid contents in areas fitted with the sewage system, where the night-soil goes into the sewers and is dealt with separately and only other refuse like street sweepings, market and slaughter-house wastes are available for compost preparation. In such cases, the levels of nitrogen and phosphoric acid are likely to be lower than when night-soil is used as the starter. It would also be interesting to examine whether a similar quantitative relationship exists between the levels of nitrogen and phosphoric acid in other types of compost e. g., farm compost and farm yard manure. If the relationship is found to be similar in all cases, then it must be associated with the changes during microbial decomposition and the synthesis of microbial tissues with more or less constant N : P_2O_5 ratio (Waksman, 1952).

From another angle, the establishment of a quantitative relationship between nitrogen and phosphoric acid in composts would throw new light on methods for increasing the nitrogen content of compost manure. Evidently, the simultaneous addition of a phosphatic supplement to compost along with

a nitrogenous starter would help to conserve the nitrogen better and build a high level of nitrogen in the compost. In this connection, the results reported by Walunjkar and Acharya (1955) on the manurial value of compost prepared with addition of superphosphate are worth attention.

Summary and conclusions: A large number of compost samples received from the local bodies of the Madras State during the years 1961–62 and 1962–63 were analysed for their total nitrogen and phosphoric acid contents, and a positive correlation was found to exist between the levels of the above two plant nutrients in the composts prepared by municipalities and town panchayats in the whole of the Madras state and also in each of the various districts individually. The correlations obtained were found to be satistically significant in most of the cases. From the regression lines obtained for the municipalities and panchayats of the Madras state, it is concluded that the phosphoric acid content of municipal compost is in general higher than that of the compost prepared by town panchayats. The higher level of phosphoric acid in municipal compost is possibly due to the more complete collection of night-soil and its addition in larger proportion to compost in municipal areas, as compared to panchayat areas. It may also partly be due to the larger quantities of slaughter-house and meat-stall wastes available in municipal areas for composting. The establishment of a significant quantitative relationship between the nitrogen and phosphoric acid levels of urban compost is of broader significance in composting since it would suggest the advisability of adding a phosphatic supplement, in addition to a nitrogenous starter, in order to build up the nitrogen level of compost manure.

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