

## An Evaluation of Indices of Available Nitrogen in Soils of Madras State<sup>\*</sup>

by

R. SIVASANKARABABU<sup>1</sup> and A. DHANAPALAN MOSI<sup>2</sup>

**Introduction:** Soil testing for available N is not comparatively as simple as in the case of soil test for available P or K. Many indices of N availability have been followed by different workers. These indices mainly fall under three major categories, namely, measurement of the potential source of mineralisable N, measurement of N mineralised by some chemical treatment and the measurement of N mineralised during incubation. Attempts have been made in the past to correlate the N values obtained by one or the other method with crop yield and N uptake. The alkaline permanganate oxidisable N is being used as an index of available N in Tamil Nadu. The present investigation was conducted to evaluate the merits of this soil N availability index and also of the four other indices, namely, total soil N, organic carbon content of the soil, nitrate N and ammoniacal N. The relationships between the alkaline permanganate oxidisable N and the other four indices were also studied in order to find out whether the former index could be substituted by the latter indices.

**Materials and Methods:** Sixteen samples of black soil, eight samples of alluvial soil, nine samples of red soil and four samples of laterite from selected spots in Tamil Nadu were taken for the study. CO 7 *Ragi* was grown in pots with these samples and the crop was applied with 40 lb of N, 20 lb each of P and K initially. The soil was analysed before planting and after harvest of the crop for available N. Alkaline permanganate oxidisable N (Subbiah and Asija 1956), total N, organic carbon (Walkley and Black 1934), ammoniacal N and nitrate N (Middleton, 1959) were used as indices of available N. The N values were correlated with crop yield and N uptake. Correlations between methods were also worked out.

**Results and discussion:** Table 1 shows the results of statistical analysis for correlations. Close correlation was obtained between the pre-planting and post-harvest values of all indices except ammoniacal N. This suggested that the relationship between the values of these methods and the crop yield and N uptake holds good irrespective of the time of sampling. Alkaline permanganate N values correlated significantly with straw yield and N uptake at 0.1% level but not with grain yield. However, a close correlation of the values of

<sup>\*</sup>Part of the Dissertation submitted for M.Sc. (Ag.) in Soil Science, University of Madras.

1. Assistant Lecturer in Chemistry and 2. Reader in Soil Science, Agricultural College and Research Institute, Coimbatore-3.

TABLE 1. Results of statistical analysis for correlation

S: No.	Independent variable X	Dependant variable Y	Correlation coefficient 'r'	Regression equation	No. of pairs 'N'
<i>Alkaline permanganate nitrogen versus straw yield and nitrogen uptake</i>					
1.	Alkaline permanganate nitrogen	Straw yield	0.63***	$Y=0.01 X+ 2.06$	37
2.	"	Nitrogen uptake	0.86***	$Y=0.56 X+ 7.42$	37
<i>Alkaline permanganate nitrogen versus nitrogen values by other methods</i>					
3.	Alkaline permanganate nitrogen	Ammoniacal nitrogen	0.77***	$Y=0.011 X- 0.92$	37
4.	"	Nitrate nitrogen	0.53***	$Y=0.39 X+ 0.07$	37
5.	"	Organic carbon	0.78***	$Y=8.65 X+128.68$	37
6.	"	Total nitrogen	0.86***	$Y=3.89 X+ 24.47$	37
<i>Available nitrogen - Initial versus final sample values</i>					
7.	Initial alkaline permanganate nitrogen	Final alkaline permanganate nitrogen	0.59***	$Y=0.23 X+ 54.92$	37
8.	Initial nitrate nitrogen	Final Nitrate nitrogen	0.47**	$Y=0.07 X+ 6.03$	37
9.	Initial organic carbon	Final organic carbon	0.93***	$Y=0.88 X+165.57$	37
10.	Initial total nitrogen	Final total nitrogen	0.97***	$Y=0.9 X+ 68.73$	37

\*\* Significant at 1% level

\*\*\* Significant at 0.1% level

this index with the grain yield also was obtained by Subramanian (1962). So, alkaline permanganate N was taken as a good index of available soil N. Comparison of the test values of other methods with those of alkaline permanganate method also gave significant, positive relationships. The closeness of the relationship was in the following descending order; Total N, organic carbon, ammoniacal N and nitrate N. Considering all the five indices studied, alkaline permanganate N, total N, organic carbon ammoniacal N and nitrate N can be taken as a good index of the available soil N in the decreasing order of merit. The close relationship of organic carbon and total N values with alkaline permanganate values is obviously clear since the latter method estimates a fraction of the potential N in the soil represented by the organic matter and total N values. A high correlation between organic carbon values and the values of alkaline permanganate method suggested the possibility of using organic carbon estimation as an alternative to the alkaline permanganate method. Organic carbon estimation as an index of available N was also recommended by Cornfield (1952) and Kalbande (1964). Moreover, rapidity of estimation is an advantage in the organic carbon method.

Total N values had the highest correlation with alkaline permanganate values suggesting that total N determination is also efficient in indicating the available N status of the soils. The total N estimation was found to be a satisfactory index of available N by Fraps (1931), Smith (1952), Andharia *et al* (1955) and Spencer *et al.* (1966). So, the present finding is in line with the view of these workers. In comparison, the total N estimation was found to be a little superior to the organic carbon estimation. But Krishnamoorthy (1966) found both the estimations to be equal in their efficiency to measure the N supplying power of the soil. In his study, nitrate N determination rates second to the alkaline permanganate method. But in the present investigation, nitrate N was found to be inferior to the total N, organic carbon and ammoniacal N methods, and had a less close correlation with alkaline permanganate method than did the other methods. Hence, the reliability of nitrate N determination for estimating the N supplying power of soils is found to be variable.

**Summary and conclusions:** Alkaline permanganate method gave a close correlation with straw yield and N uptake. The other methods, namely, total N, organic carbon, ammoniacal N and Nitrate N, were correlated to this method and the closeness of their relationship to alkaline permanganate method was in the following decreasing order: total N, organic carbon, ammoniacal N, nitrate N. Possibility of using organic carbon estimation as an alternative for the alkaline permanganate method was also suggested. Significant, positive relationship between total N and alkaline permanganate oxidisable N was observed and hence, the suitability of adopting total N as an index of available N was also indicated.

**Acknowledgment:** The authors are grateful to Dr. D. Raj, Professor of Soil Science, Agricultural College, Coimbatore for kindly suggesting the problem, and to the University of Madras for kindly granting permission to publish the above work which formed part of the dissertation done by the first author under the guidance of the second author.

#### REFERENCES

- Angharia, R. M., G. Stanford and Schaller. 1955. Nitrogen status of Marshall silt loam as influenced by different crop rotations. *Soil Sci. Soc. Amer. Proc.* 17: 247-51.
- Cornfield, A. H. 1952. The mineralisation of the nitrogen of soil during incubation. Influence of pH, total. *J. Sci. Food Agric.*, 3: 345-9.
- Fraps, G. S. 1931. How reliable are existing methods for determining soil deficiencies in ash constituents of plants. *J. Am. Soc. Agron.*, 28: 337-52.
- Kalbande, A. R. 1964. Evaluation of nitrogen supplying power of some soils of Delhi State. *J. Indian Soc. Soil Sci.*, 12: 63-70.
- Krishnamoorthy, K. K. 1966. Studies on Soil Nitrogen. Doctoral thesis submitted to and accepted by the Madras University.
- Middleton, K. R. 1959. The use of orange I method for determining soil nitrates and a comparison with the phenol-sulphuric acid method for certain soils of Northern Nigeria. *J. Food Agric. Sci.*, 10: 218-24.
- Smith, G. E. 1952. Soil fertility and corn production. *Missouri Agr. Expt. Sta. Bull.* 583.
- Spencer, W. F., A. J. Mackenzie and F. G. Viets Jr. 1966. The relationship between soil tests for available nitrogen and uptake by various irrigated crops in the Western States. *Soil Sci. Soc. Amer. Proc.*, 30: 480-5.
- Subbiah, B. V. and G. L. Asija. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, 25: 259-60.
- Subramanian, T. L. 1962. Relationship between soil nitrogen and phosphorus tests and crop yield and nutrient uptake in representative South Indian Soils. Dissertation for M.Sc.(Ag.) submitted to and accepted by the University of Madras.
- Walkley, A. and I. A. Black. 1934. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci.*, 37: 29-38.