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A simple microdiffusion method for the estimation of soil available nitrogen.

T.M. THIYAGARAJAN AND P. JANAKI

Centre for Soil and Crop Management Studies, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu

Abstract : Organic carbon content and alkaline permanganate-oxidizable N (KMnO4-N) are two indices extensively used to assess the available N status of soils. The microdiffusion method proposed by Cornfield is another technique used to estimate the soil available nitrogen and this method has not been so far evaluated for the soils of Tamil Nadu. In the original method, the Conway unit is used for diffusion and absorption of the released ammonia. Since the cost of the Conway unit is more, the original technique has been slightly modified and its performance is evaluated using forty soil samples collected from different parts of Tamil Nadu. Significant correlations of microdiffusion-N with organic carbon and $KMnO_4$-N were obtained with r^2 values of 0.777 and 0.688 respectively. The results revealed the suitability of the modified technique for wider use since it is cheaper and can be adopted for reliable estimation of soil available nitrogen. *(Key Words: Microdiffusion-N, Organic carbon, Available N estimation).*

Assessment of native N supply is an important component of efficient N management in crop production. Organic carbon content and alkaline permanganate-oxidizable N ($KMnO_4$-N) are the two indices that are extensively used to assess the available N status of soils (Sahrawat, 1982). The microdiffusion method (Cornfield, 1960) was evaluated by Keeney and Bremner (1966) and was found to correlate well with N uptake of rye grass. This method has not been so far tried for evaluating the soils of Tamil Nadu. In the original method proposed by Cornfield, the Conway unit was used for diffusion and absorption of the released ammonia. Since the Conway unit costs more, the original technique has been slightly modified. In the modified technique, instead of the Conway Unit, petridishes of 15 and 7.5 cm diameter are used as outer and inner chambers respectively (Fig 1). Hence this study was carried out with the prime objective of evaluating the validity and performance of the modified technique in the estimation of soil available nitrogen. In this study available N content of soils of different locations of Tamil Nadu was assessed by the modified microdiffusion method and the values were compared with organic carbon content and alkaline $KMnO_4$-N.

Materials and Methods

Forty soil samples collected from different locations of Tamil Nadu were used. The texture of the soils was determined by feel method and the colour was noted using a Munsell colour chart. Electrical conductivity and pH (Jackson, 1973), organic carbon (Walkley and Black, 1934) and alkaline permanganate N (Subbiah and Asija, 1956) were estimated by following the standard procedures.

The principle involved in microdiffusion method of N estimation is the oxidisable N present in the soil is converted into ammonia gas through hydrolysation using 1.2N sodium hydroxide (NaOH). The released ammonia gas which is ceaselessly coming out in diffusion is absorbed by the 2% boric acid-indicator and is determined by titration with standard acid solution.

The procedure followed is outlined as below: 2g of soil was taken in the outer chamber of the petridish unit (Fig.1) and spread evenly by revolving the dish. 5ml of 2% boric acid with double indicator was added to the inner chamber (small petridish kept at the center of the larger one) and the unit was closed air tightly by applying the specially prepared gum arabica glue on the lid of the outer petridish. The lid was rotated several times both clock wise and anticlock wise to gum it firmly. The lid was slowly opened to make a slot and 10 ml of 1.2N NaOH was added rapidly in the outer chamber in which the soil had already been spread and the lid was closed immediately. Again by rotation, the soil sample was mixed with NaOH and kept at room temperature. After 24 hrs the unit was opened and the ammonia collected in the boric acid was determined by titration with 0.01 N HCl taken in a microburette of 5ml capacity. Using the titre value the content of hydrolysable N in the soil was calculated.

Results and Discussion

Analysis of Soil

The characteristics of the soils collected from different locations are given in Table 1. The soils used in this study differed markedly in pH (4.4 to 8.4), electrical conductivity (0.1 to 2.7 dSm^{-1}), organic carbon content (2.1 to 24.4 g kg^{-1}) and the $KMnO_4$-N content (111 to 475 kg ha^{-1}). The texture of the soils

Table 1. Soil characteristics and available N status by different methods.

S.No.	Location	Munsell colour	Texture	pH	EC (dSm^{-1})	Micro diffusion-N ($kg\ ha^{-1}$)	$KMnO_4$-N ($kg\ ha^{-1}$)	Organic carbon ($g\ kg^{-1}$)
1	Kanyakumari	5YR*4/5*	sl	4.4	*.55*	218	220	7.2
2	Bhavanisagar	5YR4/3	scl	4.9	0.27	188	161	8.2
3	Sirugamani	7.5YR4/2	scl	8.1	0.99	185	226	7.0
4	Virudhachalam	2.5YR4/4	sl	8.2	0.31	161	180	2.7
5	Cuddalore	1OYR3/2	sl	7.1	0.24	181	138	7.1
6	Trichy	1OYR4/1	sc	7.8	0.16	189	166	7.6
7	Madurai	1OYR3/3	c	6.7	0.17	239	251	10.6
8	Mettupalayam	5YR4/4	sls	7.1	0.08	148	180	3.2
9	Srivilliputtur	1OYR3/2	c	7.8	0.26	226	216	5.8
10	Tanjore	1OYR3/2	c	8.3	0.48	208	177	11.5
11	Aliyar	7.5YR4/2	sl	8.4	0.29	158	148	4.0
12	Kallakuruchi	5YR4/4	scl	5.3	0.21	180	111	6.0
13	Tirur	5YR4/3	scl	7.8	0.13	168	158	6.7
14	Kurtalam	7.5YR4/2	scl	*5.5*	0.17	320	181	13.2
15	Salem	1OYR4/1	c	7.6	1.24	249	190	11.4
16	Namakkal	5YR5/4	scl	8.0	0.17	153	154	6.6
17	Virinjipuram	7.5YR4/2	sl	7.3	0.21	174	168	3.1
18	Aruppukottai	1OYR3/2	c	8.1	0.11	172	158	6.1
19	Kangayam	7.5YR4/2	sc	7.9	1.17	177	180	7.9
20	Coimbatore-PBS	1OYR4/2	c	8.0	0.38	210	166	6.9
21	Coimbatore-WL-F4	1OYR4/2	c	8.1	0.51	212	163	5.7
22	Coimbatore-WL-E2	1OYR4/2	c	8.3	0.43	285	213	10.1
23	Coimbatore-WDI	1OYR4/2	c	5.1	0.43	221	189	10.6
24	Coimbatore-F.NO.37	1OYR3/2	c	8.3	0.93	139	111	8.6
25	Coimbatore-CBS	5YR4/3	cl	8.0	1.65	185	133	6.0
26	Coimbatore-MBS	5YR4/3	cl	8.1	1.25	125	113	2.0
27	Coimbatore-New area	7.5YR4/2	cl	7.9	2.26	193	175	5.6
28	Coimbatore-Eastem block	1OYR3/2	cl	8.3	0.37	212	181	7.9
29	Gobi	7.5YR4/2	scl	8.0	0.23	188	182	4.2
30	Dharmapuri	1OYR3/2	c	7.9	2.70	158	140	6.0
31	Palladam	1OYR4/3	cl	8.2	0.34	125	144	6.8
32	Andiyur	1OYR3/2	cl	8.0	0.41	168	160	7.6
33	Ottansatarum	5YR4/2	ls	8.4	0.17	212	192	10.8
34	Thadiyankudisai	5YR4/3	scl	5.9	*0.05*	181	168	14.4
35	Valparai	5YR4/8	ls	5.5	0.55	330	311	24.4
36	Aduthurai	7.5YR4/2	c	7.5	0.31	502	475	10.8
37	Ambasamudram	7.5YR4/2	sl	6.1	0.40	188	162	10.8
38	Nagapattinam	1OYR4/3	cl	6.9	0.40	241	194	2.1
39	Vamban	5YR4/4	s	7.0	0.47	201	176	3.0
40	Paiyur	5YR4/3	ls	6.8	0.25	183	166	6.0

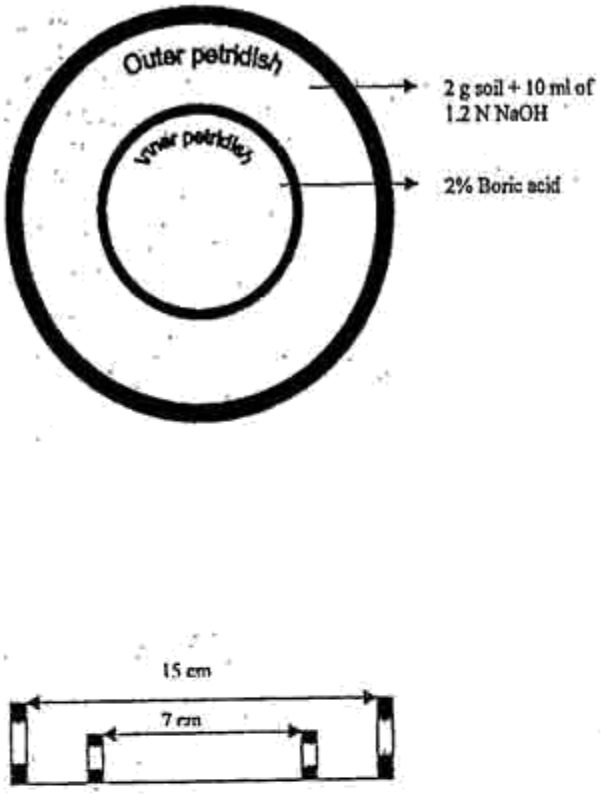

Fig.1. Modification of Conway unit by using petridish for micro diffusion

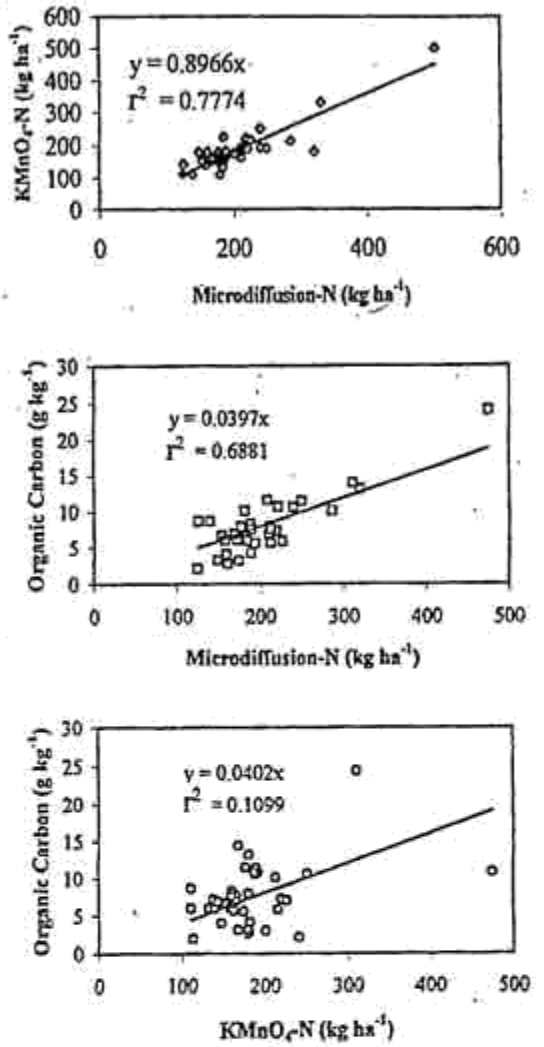

Fig.2. Correlation of Microdiffusion-N and $KMnO_4$-N with Organic Carbon status.

varied from loamy sand to clayey and the colour varied from reddish brown to dark grey. The average available N content of the soils as determined by the modified microdiffusion method ranged from 125 to 502 kg ha^{-1}. Therefore, the soils used in this study represented the various types like acid to near alkaline, sandy to clayey, soils from plains to hilly areas, and red to black soils. The crops grown in the areas from where the soils had been collected are rice, groundnut, cole crops. tea, teak, cowpea, sugarcane, sorghum, cumbu, maize and vegetables.

In order to find out the usefulness of this technique, the correlations of microdiffusion-N with organic carbon and KMnO4-N were worked out and the correlations were found to be significant (Fig. 2.) with r^2 values of 0.777 and 0.688 respectively. The significant results showed that the modified microdiffusion-N technique is quite suitable and convenient for the estimation of available N content for different types of soils. The correlation of organic carbon with $KMnO_4$-N was very poor, the r^2 value being 0.109 as against the value of 0.688 for the correlation of organic carbon with microdiffusion-N. This shows that the organic carbon content of soils is more related with microdiffusion-N than with $KMnO_4$-N thereby indicating the suitability and usefulness of the new modified technique in estimating the soil available N.

Merits and Demerits of the technique

1. This new method is simple, requires less chemicals and can be used for the analysis of a large number of samples.
2. This technique can be used only if sufficient number of petridishes are available.
3. Cost effective because no gas is required for heating as in the case of $KMnO_4$-N method.

4. The amount of soil required is less; however the soil is to be ground to very fine particles.

The modified technique is cheaper and also can be done with petridishes. This method can be adopted for reliable estimation of soil available N.

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Long term performance of cardamom - an economic appraisal

V.S.KORIKANTHIMATH, GOVARDHAN RAO AND G.M.HIREMATH

Indian Instt. of Spices Research, Cardamom Res. Centre, Appangala, Madikeri - 571 201

Abstract : Field trials were conducted by adopting High Production Technology (HPT) at Chettalli (Coorg District, Karnataka) to study the sustained yield, various input requirement and the economics in cardamom (*Elettaria cardamomum* Maton) cultivation in the long term. Highest yield of 1,625 kg ha^{-1} (dry) was obtained during the fourth year of planting. On an average for ten crop seasons, 662.72 kg ha^{-1} (dry) capsules was obtained in the trials which is almost five times more than the national average yield of 140 kg ha^{-1}. Cultivation of cardamom is found to be highly labour intensive. Out of 729.59 labour days required per ha per year during bearing period, the women labourers constituted a major chunk (64.08 per cent). About 55.56 per cent and 11.01 per cent of labour requirement was for harvesting and trashing operations respectively. A net income of Rs.1,09,147.53/ha (average of 10 crop seasons) was obtained with a production cost of Rs.60.92 per kg (dry). (Key words: Cardamom, Long term performance, Economics).

Cardamom (*Elettaria cardamomum* Maton) known as 'Queen' of spices is native of India which is invariably cultivated in the high ranges of western ghats of South India in a self sustainable forestry system. It is cultivated with least disturbance to the natural forest flora as compared to other plantation crops like tea and rubber which require near clear felling of trees (Korikanthimath, 1993). It was grown in an area of 72,444 ha mainly in Kerala (56.91per cent), Karnataka (35.96 per cent) and Tamil Nadu (8.13 per cent) during 1998. Due to an intensive competition from Guatemala, India lost its premier position in cardamom production. The rate of growth of cardamom production in Guatemala during the late seventies has been over 14 per cent compared to India's growth rate of 0.7 per cent. Thus India's competitiveness in the world market also suffered (Chandrashekhar, 1988). Sixty nine per cent of cardamom plantations in India are below 2 ha and are the main source of employment to small and marginal farmers (Cardamom Board, 1985). Hence, adoption of intensive cultivation practices for higher yields especially in small holdings and efficient utilisation of labour needs no emphasis (Bavappa 1977; Korikanthimath *et al.*, 1989). Only way out for the stiff international market competition is 'high productivity and low cost of production per unit area' to ensure survival of cardamom industry in India (Korikanthimath, 1990b). This would be of paramount importance to the wide range of users and planners for cost analysis so as to decide upon the long term benefits of cardamom cultivation.

Hence, studies were undertaken at M/S Chettalli estate, Chettalli (Coorg district, Karnataka) from 1982 onwards for evaluating the long term