Short Communication

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Nitrogen Supplying Capacity of Soils Having Previous Cropping and Fertilization History

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The objective of this study was to evaluate an incubation and some chemical methods including $KMnO_4$ method, organic N, total N and mineral N (2N-KCL extractable) contents of soil for predicting soil N availability to wheat on 9 soils having different cropping and fertilization background.

The nine soils used were collected from a long term fertility experiment established at Sindh Agricultural University, Tandojam in 1983. The experiment involved three cropping sequences and three fertilization rates for each crop in the sequence (Table 1). By the time of sampling, two crops of each species in each cropping sequence had been harvested. Physicochemical characteristics of the soils are given in Table 1.

For incubation study, 100g portion of each soil was incubated, in quadruplicate, at 30± 1° for 8 weeks in flatbottomed plastic vessels having hole in the lid for gaseous exchange. The NH_4 and NO_3-N contents of soils, after extraction with 2N-KCL were determined by steam distillation with MgO and Devarda's alloy after 2,4,6 and 8 weeks.

For determining oxidative release of soil N by permanganate method, 2g of soil sample were shaken with 50 ml of 1N H_2SO_4 in centrifuge tube for 1 hr. After centrifugation, the supernatent was discarded and residue reshaken with for another hr. with 50 ml of different concentrations of freshly prepared acid $KMnO_4$ solution. After centrifugation, the supernatent was collected and analyzed for NH_4-N using MgO and NaOH as alkalizer. The organic matter content was determined by Walkley and Black method [1] and total N and mineral N according to methods of Bremner [2].

For N uptake studies, 3 kg of each soil, in quadruplicate, was filled in plastic pots. No N fertilizer was added. The soil, after bringing to field capacity, was sown to wheat, cv. Blue silver. The plants were harvested 40 days after germination. After even drying, their dry weights were recorded and plants analysed for N content by Kjeldahl method.

It was observed that all the methods used for determining nitrogen supplying capacity of soil gave higher correlation with N uptake than with dry matter weights of wheat.

The incubation method, in the present study, failed to give an indication of mineralizable N in the soil. The values of mineral N released on incubation of soil samples did not correlate significantly with either the dry matter weights or N uptake by wheat. The reason may be the high values of mineral N at zero time. The values were so high that an increase in mineral N could not be detected. The values of mineral N released on incubation were, however, higher at 4 weeks than at other periods of incubation.

TABLE 1. THE PHYSICOCHEMICAL CHARACTERISTICS OF THE SOILS USED.

No.	Cropping sequence/ fertilizer rates.	pH	Org. matter (%)	Total N (%)	Clay (%)	Texture	Mineral† N (µg/g)
	(A)*Wheat-fallow-wheat*						
1	(i) 0-0	8.3	0.87	0.057	30.0	CL	177.6
2	(ii) 150-0 (for wheat)	7.9	0.92	0.057	32.5	CL	203.5
3	(iii) 150-60 (for wheat)	7.9	0.94	0.059	27.5	CL	209.6
	(B)*Wheat-maize-wheat*						
4	(i) 0-0	8.1	0.83	0.057	32.5	CL	149.0
5	(ii) 150-0 (for wheat and maize)	8.1	0.85	0.057	32.5	CL	159.3
6	(iii) 150-60 (" " " ")	8.0	0.90	0.056	30.0	CL	189.8
	(C)*Wheat-soybean-wheat*						
7	(i) 0-0	8.1	0.83	0.057	30.0	CL	142.6
8	(ii) 150-0 (wheat) / 30-0 (soybean)	8.1	0.83	0.057	30.0	CL	152.9
9	(iii) 150-60 (wheat)/ 30-60 (soybean)	8.2	0.87	0.058	30.0	CL	152.6

† Initial total mineral (NH_4 + NO_3) N extracted by 2N-KCl; CL = Clay loam.

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The amount of mineralizable N extracted by different concentrations of acid $KMnO_4$ solution correlated significantly with N uptake (Table 2). With the concentration of 0.05N, the correlation was significant for dry matter weight (r=0.68) and highly significant for N uptake (r=0.80). With increasing concentrations of $KMnO_4$, the values of r decreased. The correlation, however, improved when initial mineral N (2N KCL extractable) resulting from past fertilization was included in the $KMnO_4$-extractable N (Table 2). Similar results were reported by Hussain *et al.* [3] and Stanford and Smith [4].

The data in Table 2 showed that organic matter content was significantly correlated with dry matter yield and N uptake by wheat. This is as expected because organic matter serves as a storehouse/source of organic nitrogen in soil from

TABLE 2. CORRELATION BETWEEN VALUES OF AVAILABLE SOIL NITROGEN DETERMINED BY DIFFERENT METHODS AND DRY MATTER WEIGHTS AND N UPTAKE BY WHEAT.

No.	Method / Measure of variable soil-N	Correlation coefficient (r values) Dry matter	N uptake
1.	Soil incubation at		
	2 weeks	0.431	0.616
	4 weaks	0.586	0.516
	6 weaks	0.360	0.313
	8 weaks	0.111	0.063
2.	Acid permanganate method		
	(i) Mineralizable N extracted by		
	0.05N $KMnO_4$	0.681*	0.803**
	0.1 N "	0.537	0.754*
	0.2 N "	0.479	0.735*
	(ii) Mineral N (2N-KCl extractable) plus mineralizable N extracted by		
	0.05N $KMnO_4$	0.697*	0.951**
	0.1 N "	0.649	0.931**
	0.2 N "	0.654	0.931**
3.	Mineral N (2 N-KCl extractable)	0.600	0.905**
4.	Organic matter	0.672*	0.931**
5.	Total N	0.322	0.422

* Significant at 5% level of significance.
** Significant at 1% level of significance.

where the amounts of mineral N are released depending upon the prevailing conditions of moisture, temperature, aeration, oxidizable energy material, etc. This observation is consistent with the findings of other research workers [5-7]. The mineral N content (2N-KCL extractable) of soil also correlated significantly with N uptake whereas total N content was not correlated significantly with N uptake or dry matter yield. According to these results, mineral N or organic matter contents were as efficient methods for mineralizable N as $KMnO_4$ method, however, organic matter or mineral N are more easy to estimate.

Previous cropping and fertilization history influenced the nitrogen supplying power of soils. The average total mineral N values, determined by acid permanganate and incubation methods (data not shown) and as organic matter and KCL extractable $NH_4 + NO_3$-N contents (Table 1), were higher under wheat-fallow-wheat cropping sequence than the other two sequences thereby underlining the importance of practice of fallowing for maintaining/improving fertility of the soil. The plots fertilized with N and N+P had almost similar mineral N contents which were higher than the unfertilized plots.

Key words: Mineralizable N, Organic matter, Cropping sequence, Fertilization.

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