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NITRIFICATION OF COMPLEX FERTILIZERS AT HEAVY DOSES

BY

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ABSTRACT

An incubation experiment was conducted with three complex fertilizers and one straight fertilizer in red and black soils at 60 per cent water holding capacity. The nitrogen was applied at four different doses. The results showed that over a period of 30 days incubation the nitrate formation was high and quick in the case of ammonium nitrate and Suphala even at high doses of application. Madras fertilizer complex and Parry complex did not record high nitrate content as in the case of others and thus the nitrification was slower in these cases. The nitrification was quicker in Suphala by which it could be said that better efficiency will be there for Suphala when applied to garden land crops and Madras fertilizer and Parry complexes may perform better in paddy soils than in garden land soils. This conclusion is based only with reference to the nitrification process, but other conditions may also have to be taken into consideration in deciding the suitability of a specific complex to a particular crop grown in a particular soil.

INTRODUCTION

Due to change in fertilizer policy and effective propaganda, the complex fertilizers are becoming popular and they are slowly replacing the straight fertilizers. Different types of complexes having varied analysis, composition, components and other physical and chemical properties are being made available and the farmers have already started using indiscreminately all available complexes in view of the fertilizer scarcity on one hand and due to the necessity of using fertilizers for getting more yield on the other. It is doubtful whether all these complexes will behave similarly and hence to find out the value of the complexes the present investigation has been taken up with the aim of finding out the release of nitrogen from different complexes.

MATERIALS AND METHODS

Three complex fertilizers *viz.*, Madras fertilizer complex (T_1), Suphala complex (T_2) and Parry complex (T_3) were compared with a straight fertilizer ammonium nitrate (T_4) on black and red soils in an incubation experiment. The analytical data for the fertilizers and soils are:

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Fertilizer sampl	% of N : P_2O_5 : K_2O
T_1 + Madras fertilizer complex	15 : 15 : 15 (N as NH_4-N only)
T_2 Suphala comple:	15 : 15 : 15 (55% NH_4-N + 45% NO_3-N)
T_3 Parry complex	14 : 14 : 14 (N as NH_4-N only)
T_4 Ammonium nitra	33 : 0 : 0 (50% NH_4-N + 50% NO_3-N)

	Soil Samples	
	Black	Red
pH	7.8	6.0
Water holding capacity %	62.2	48.9
Clay %	48.3	51.3
Total nitrogen %	0 0448	0.0658
Available nitrogen - ppm	56	84
Ammoniecal nitrogen - ppm	7	7
Nitrate nitrogen - ppm	0	0
Cation exchange capacity me /100 g	33	10
Organic carbon %	0.276	0.246

The fertilizers were applied at doses to supply 50 ppm (D_1), 100 ppm (D_2), 150 ppm (D_3) and 200ppm (D_4) of nitrogen and the soils were incubated twice. Samples were drawn on the 4th (S_1), 8th (S_2) 15th (S_3) and 30th days (S_4) and the soil samples were analysed for exchangeable ammoniacal nitrogen, and nitrate as per the method of Kenny and Bremner (1966) using a Bremner and Edwards (1965) distillation apparatus. The data and the results of statistical analysis are presented in Tables 1 and 2.

RESULTS AND DISCUSSION

Nitrate Nitrogen: The results reveal (Table 1) that the nitrification after a period of 30 days was significantly higher in black soil than in the red soil. This may be due to the black soil possessing a higher cation exchange capacity (33me) than the red soil (10me). Lees and Quastel (1946) has stated that the nitrification was proportional to the cation exchange capacity. Further according to Wilson (1927) the nitrification rate falls off markedly below pH 6.0, and in neutral to alkaline soil the population of microbes will be larger. In the present study also the pH of red soil was 6.0 and that of black soil was 7.8. Thus the variation in pH between the two soil also might have resulted in the variation in nitrification process. Hence these two factors might have been responsible for the higher amounts of nitrates observed

TABLE 1.

Nitrate Nitrogen in ppm

(Values are the average of two replications)

Treatment		Black soil				Red soil			
		S_1	S_2	S_3	S_4	S_1	S_2	S_3	S_4
T_1	D_1	32.0	91.0	88.0	98.0	32.0	47.0	51.0	37.0
	D_2	28.5	94.5	121.0	144.0	30.0	12.5	23.0	28.0
	D_3	19.5	91.0	159.5	254.0	33.5	14.5	16.0	42.5
	D_4	35.5	99.5	201 5	271.5	23.0	21.0	7.0	19.5
T_2	D_1	47.5	100.0	82.5	110.5	61.5	45.5	33.5	49.0
	D_2	75.5	108.5	135.0	142.0	86.0	68.5	63.1	75.5
	D_3	98.5	159.5	170.0	217.0	112.5	106.5	84.0	123.0
	D_4	142.0	198.0	212.0	299.5	149.0	130.0	96.0	124.5
T_3	D_1	19.5	86.0	81.0	99.5	37.0	9.0	12.5	26.5
	D_2	21.0	93.0	116.0	152.5	54.5	18.0	14.5	25.0
	D_3	17.5	108.5	191.0	180.5	25.0	12.5	16.0	40.5
	D_4	24.5	93.0	178.5	249.5	23.5	12.5	9.0	21.0
T_4	D_1	56.0	91.0	80.5	107.0	70.0	68.0	72.0	53.0
	D_2	93.0	121.0	145.5	173.5	110.5	93.0	91.0	94.5
	D_3	123.0	180.5	212.0	241.5	145.5	145.5	93.0	98.0
	D_4	159.5	231.5	226.0	354.0	177.0	166.5	126.0	140.0

S_1 : 4th day
S_2 : 8th day
S_3 : 15th day
S_4 : 30th day

T_1 Madras fertilizer complex
T_2 Suphala complex
T_3 Parry complex
T_4 Ammonium nitrate

D_1 : 50 ppm
D_2 : 100 ppm
D_3 : 150 ppm
D_4 : 200 ppm

TABLE 1 (Contd.)

	S. E.	C. D.
Soils	2.85	7.92
Treatments	4.03	11.20
Doses	4.03	11.20
Stages	4.03	11.20
Soil x Treatment	5.71	15.87
Soil x Doses	5.71	15.87
Soil x Stages	5.71	15.87
Treatment x Doses	8.07	22.43
Doses x Stages	8.07	22.43
Treatment x Stages	N. S	

TABLE 2

Ammonical nitrogen in ppm

(values are the average of the two replications)

Treatements		Black soil				Red soil			
		S_1	S_2	S_3	S_4	S_1	S_2	S_3	S_4
T_1	D_1	108.5	33 5	19.5	44.0	353.5	170.0	165.0	154.0
	D_2	205.0	67.0	25.0	30.0	270.0	243.5	191.0	222.5
	D_3	254.0	124.5	51.0	26.5	378.0	382.0	270.0	262.5
	D_4	376.5	231.0	67.0	54.5	467.5	467.5	346.5	296.0
T_2	D_1	89.0	30.0	23.0	32.0	135.0	128.5	126.5	119.5
	D_2	138.5	49.5	24.5	28.5	208.5	177.0	133.5	161.0
	D_3	166.5	77.0	38.5	30.0	273.5	243.5	182.5	192.5
	D_4	248.5	143.5	45.5	52.5	313.5	266.5	222.5	194.5
T_3	D_1	124.5	40.5	25.0	31.0	317.0	170.0	130.0	138.5
	D_2	165.0	82.5	40.5	32.0	298.0	282.0	217.5	212.0
	D_3	324.0	144.0	51.0	33.5	413.5	478.0	276.5	280.5
	D_4	427.0	223.5	53.0	49.0	458.5	476.0	362.5	338.0
T_4	D_1	100.0	35.5	16.0	26.5	142.0	159.5	135.0	121.0
	D_2	144.0	45 5	35.5	30.0	213.5	198.0	159.5	152.5
	D_3	208.5	75.0	40.5	44.0	273.5	254.0	204.5	193.0
	D_4	264.5	163·0	53.0	73.5	299.5	347.0	214.0	215.5

(Legend as per Table 1)

TABLE 2 (Contd.)

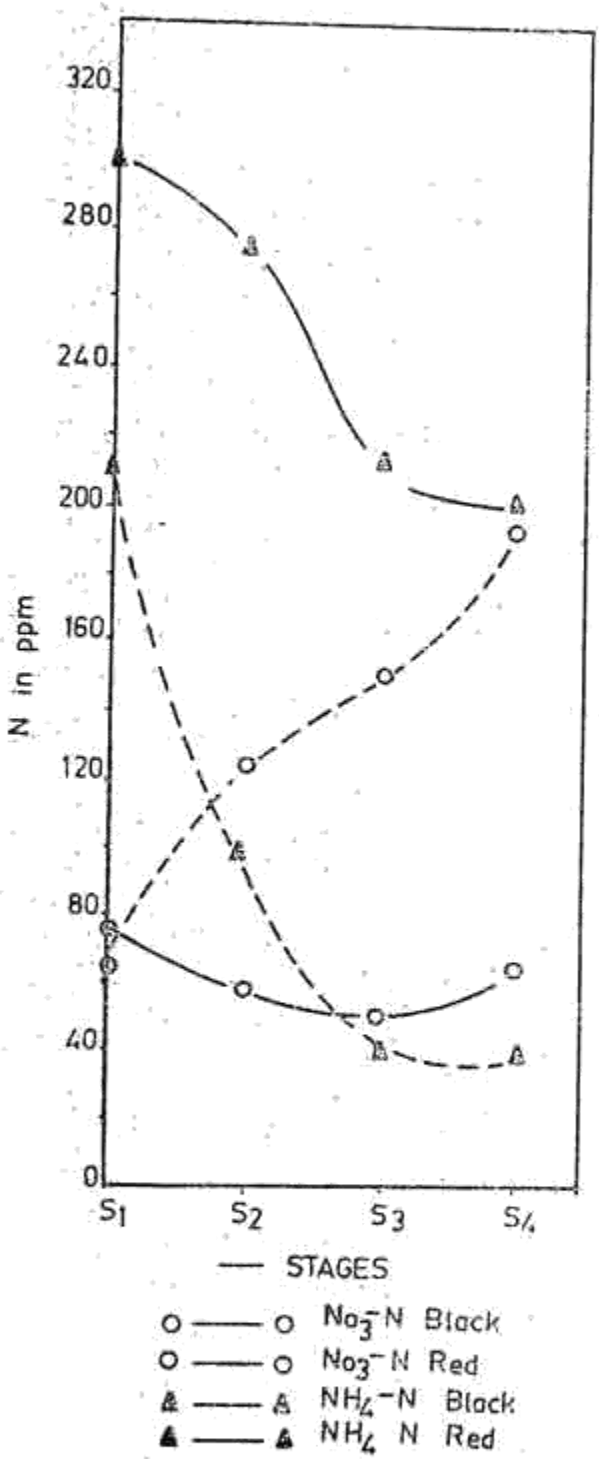
	S.E.	C. D.
Soils	2.76	7.67
Treatments	3.91	10.86
Doses	3.91	10.86
Stages	3.91	10.86
Soil x Treatment	5.53	15.37
Soil x Doses	5.53	15.37
Soil x Stages	5.53	15.37
Treatment x Doses	7.83	21.76
Doses x Stages	7.83	21.76
Treatment x Stages	7.83	21.76

in black soil than in red soil. Further as the period of incubation advanced in the red soil the nitrification was fluctuating throughout (Fig. 1), where as in the case of black soil, the nitrification increased significantly as the period of incubation advanced, ($S_4 > S_3 > S_2 > S_1$).

Among the fertilizer treatments, ammonium nitrate (T_4) was significantly superior to suphala (T_2), which in turn was significantly superior to Madras fertilizer complex (T_1) and Parry complex (T_3), but they were on a par in the matter of release of nitrate nitrogen. The superiority of ammonium nitrate (T_4) and suphala (T_2) may be due to the presence of a portion of the N as NO_3-N. In the case of ammonium nitrate the fertilizer did not contain potassium and other complexes contained potassium as a component in the fertilizer complex itself. It has been established that some of the applied ammonium is fixed by 2:1 type of clay minerals. According to Welch and Scott (1960) when potassium is present, it will block the release of this fixed ammonium and drastically affect its availability to nitrifying organisms and hence ammonium nitrate (without potassium) was superior to the other complex fertilizer in the release of NO_3-N.

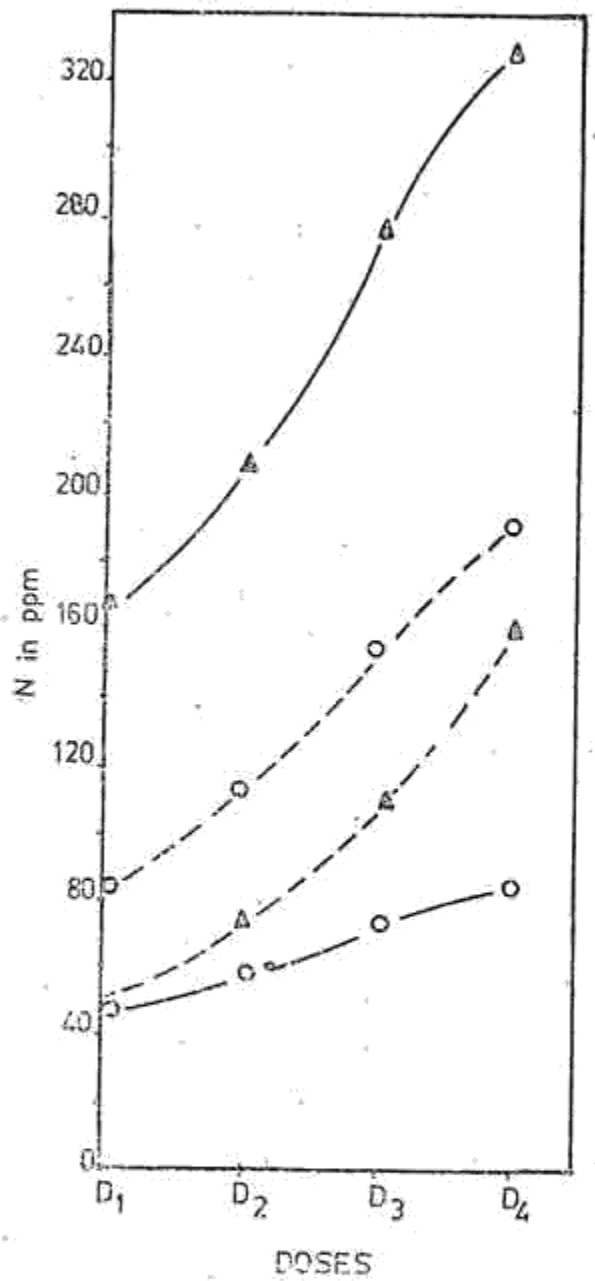
In the case of black soil the doses applied were significantly superior to one another, in the order of D_4 to D_3, D_3 to D_2 and D_2 to D_1. But in the case of red soil they were not significantly superior but the trend was fluctuating. [D_4 being on a par with D_3, D_3 with D_2 and D_2 with D_1; D_4 being significantly superior to D_2 ane D_1 (Fig. 2)]. Comparing the doses of nitrogen within treatments

FIG.1



in the case of T_1 and T_3, D_4 and D_3 were on a par, showing that the nitrification was less and inspite of the

FIG.2



increase in the dose of application the release of NO_3-N remained almost the same. But in the case of ammonium nitrate (T_4) and Suphala (T_2) the release of NO_3-N increased proportionately as the doses of application increased (i.e.) all the doses were signi-

ficantly superior to one another.(D_4 to D_2, D_3 to D_3 and D_2 to D_1).

Ammoniacal nitrogen: The results also revealed that ammoniacal nitrogen content was significantly more in the case of red soil than the black soil. This may be due to, as stated above, slower rate of nitrification in red soil compared to the black soil. When the treatments were compared between the two soils and between different doses of N application and also under different stages of sampling, the treatments, with Madras fertilizer complex and Parry complex were significantly superior to ammonium nitrate and suphala, both sets being on a par among themselves. In the case of both black and red soil and also within all treatments, all high doses were significantly superior to one another in order of D_4, D_3, D_2 and D_1 in the release of ammoniacal nitrogen (Fig. 2). The maximum ammoniacal N release was noticed on the 4th day (S_1) which was significantly superior to 8th day sample (S_2). Stages 3 and 4 were on a par among themselves (Fig. 1).

From the above results it can be stated that better efficiency can be obtained when Suphala complex is applied to the garden land crops which utilise N in the nitrate form and increased efficiency could be achieved when the Madras fertilizer complex and Parry complex are applied for rice.

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