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STUDY ON THE AVAILABILITY OF IRON CONTENT IN SOIL AS INFLUENCED BY IRON APPLICATION IN TWO KINDS

M. VEERAMANI, A. GOPALSWAMY and P. PARAMASIVAM

Department of Soil Science and Agricultural Chemistry
Agricultural College and Research Institute, Madurai-625 104

ABSTRACT

Field experiments were conducted using Typic Chromusterts (Black calcareous soil) and Typic Haplustalf (Red non-calcareous soil) with sorghum var. TNS.27 as the test crop to compare the organic sources of iron with that of the inorganic iron sources. In black calcareous soil (S_1) the treatment FYM 10 t + pyrite 700 kg/ha was found to be superior and recorded 4.8 ppm DTPA extractable Fe. The available Fe in soil was higher at 30th day and decreased thereafter (60th day and harvest stage) due to the age of the crop.

In addition to the above field experiments an incubation experiment was also conducted using the same soils (black calcareous and red-non calcareous soil) with same set of treatments to study the changes in DTPA extractable Fe status in soil for the period of 60 days under laboratory condition. This study revealed that availability of Fe content was increasing upto 45th day and decreased thereafter.

Keywords : Soil, Black calcareous, Red non-calcareous, Iron content

Among the micronutrients, the deficiencies of Zn and Fe noticed in many soils and it has been estimated that their occurence of deficiency to the tune of 36.7 per cent and 22.3 per cent respectively in the soils of Tamil Nadu (Anon, 1982). Availability of Fe is governed by many factors such as soil texture, pH, $CaCO_3$, etc. In alkaline pH its availability is restricted due to the free Ca and Mg carbonates which react with Ferrous ion and form insoluble Ferric carbonates. Babaria and Patil (1980) recorded that application of FYM 10 t/ha, sulphur at 80 ppm and Fe at 10 ppm significantly increased the available Fe in medium black calcareous soil. Gupta and Agarwal (1982) and Jaggi *et al.* (1982) reported an increase in available Fe in soil with pyrite application.

MATERIALS AND METHODS

Two field experiments were conducted in black calcareous (Typic chromusterts) and red non- calcareous soils (Typic Haplustalf) with the test crop sorghum var. TNS.27 (CO.25) in field No. 76 of Eastern block and Field No.-7E in Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu respectively during February-June, 1984. The experiments were laid out in Randomized block design with four replications. The various treatments followed in the experiments were T_1 - Absolute control, T_2 - NPK alone, T_3 - NPK + $FeSO_4$ 50 kg/ha, T_4 - NPK + 2% $FeSO_4$ foliar spray (30th, 40th and 50th day of crop growth), T_5 - NPK + 2% $FeSO_4$ + 0.1% Citric acid foliar spray (30th, 40th and 50th day of crop growth), T_6 - NPK + Pyrite 700 kg/ha, T_7 - NPK + FYM 10 t/ha, T_8 - NPK + FYM 10 t + $FeSO_4$ 50 kg/ha and T_9 - NPK + FYM 10 t + Pyrite 700 kg/ha.

A common dose of 90 : 45 : 45 kg N, P_2O_5 and K_2O/ha was applied in all the treatments except absolute control in the form of urea, super and muriate of potash. Half of N was applied basally along with entire dose of P_2O_5 and K_2O and the rest of N was top dressed on 30th day after sowing. The Fe-enriched organic manure was prepared by mixing $FeSO_4$ at 50 kg/ha and Pyrite at 700 kg/ha with 10 tonnes per ha of well decomposed FYM and incubated for 10 days under anaerobic condition and then applied basally (Sakal *et al.,* 1982).

The pH and E.C. recorded were 8.4 and 0.3 m.mhos/cm in black calcareous soil and 7.9 and 0.2 m.mhos/cm in red non-calcareous soil respectively. The available Fe content was 3.65 and 3.00 ppm in red non-calcareous soil and black calcareous soil respectively. Based on the critical limit of 3.75 ppm DTPA Fe (Savithri, 1978), both soils were found to be deficient in the available iron status. The soil samples were collected from the various treatments during 30th and 60th day and harvest stage of the crop.

An incubation experiment was also conducted using the same soils (S_1 and S_2) collected from the field experiments with same set of treatments except foliar spray and NPK alone treatments with three replications. The collected soil samples were air dried and one kg of soil was taken in clean plastic pots and watered maintaining at 60 per cent water holding capacity throughout the incubation period. The soil samples from the incubation experiment were drawn 1st, 3rd, 7th, 15th, 30th, 45th and 60th day. The samples were extracted with DTPA extractant and estimated the Fe content (Lindsay and Norvell, 1978).

RESULTS AND DISCUSSION

Available iron in soil at different stages of crop growth

In black calcareous soil (S_1), the treatments T_9 (FYM 10 t + pyrite 700 kg/ha) was found to be superior compared to all other treatments and recorded 4.8 ppm of Fe followed by the treatment T_6 (Pyrite 700 kg/ha) which recorded 3.9 ppm. In red-non-calcareous soil (S_2) the treatment T_8 (FYM 10 t + $FeSO_4$ 50 kg/ha) registered higher value (3.9 ppm) followed by the treatment T_5 (3.7ppm). Chandrasekaran (1976) and Kanagaraj (1979) observed that the available Fe increased by the application of Fe.

Higher available Fe content in soil (4.3 ppm) was registered in the treatment T_9 and was on par with the T_8. The higher availability of Fe due to the addition of pyrite in combination with FYM might be due to the Fe complexes formed by the action of functional groups released during the decomposition of organic manure on the metal ion *viz.,* the Fe released from pyrite. This was in consonance with the findings of Singh and Sinha (1977) who reported that when pyrite was amended with organic manures prior to its application in the soil, there was the complexation of Fe by the organic lignands in these manures and the Fe complexes thus formed were found to be fairly stable in the alkaline pH range of of these soils. Gupta and Agarwal (1982) also reported the greater availability of Fe in soil with increasing level of pyrite. Similar trend was also observed by Jaggi *et al.* (1982). The available Fe content decreased with the age of the crop in the soil thereby showing the greater utilization of Fe by plants. There was only slight decrease in the available

Table 1. Available iron status of soil in ppm DTPA Fe

Treatment	30th day		60th day		Harvest stage		Mean	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	2.7	2.9	2.4	2.0	1.2	1.8	2.1	2.2
T_2	2.4	2.8	2.0	2.4	1.2	2.0	1.9	2.4
T_3	3.8	4.2	3.4	3.2	2.5	2.4	3.2	3.3
T_4	2.8	3.2	2.4	2.0	2.2	1.6	2.5	2.3
T_5	2.8	3.0	2.3	2.4	1.9	2.0	2.0	2.5
T_6	4.8	3.6	3.8	3.4	3.0	3.2	3.9	3.4
T_7	3.2	3.8	2.8	2.9	2.0	2.2	2.7	3.0
T_8	4.9	5.4	4.2	3.4	2.4	2.9	3.8	3.9
T_9	5.2	4.4	4.6	3.5	4.5	3.3	4.8	3.7

	SE(D)	C.D.
Stage	0.11	0.23
Treatment	0.19	0.40
Soil x Treatment	0.29	0.56
Soil	NS	

S_1 = Black calcareous soil S_2 = Red non-calcareous soil

content of Fe in soil due to the application of pyrite along with FYM compared to the other treatments and this might be due to the increased availability of Fe from the native and applied sources (pyrite) and affected by organic manures.

The correlation studies indicated the existence of a significant positive relationship between the available Fe content in soil at harvest stage and in the grain and straw yields (0.769** and 0.790** respectively) in the case of black calcareous soil. Though there was positive relationship for the red non-calcareous soil yet the level of significant for the same was not obtained (Table 1).

Availability of Fe in soil at different periods - Incubation experiment

The Fe availability significantly increased with increasing in bation period. The increase in the Fe availability was noticed upto 45th day (7.71 ppm DTPA Fe), thereafter there was a slight decrease in the same (7.43 ppm DTPA Fe on 60th day). The result corroborated with the findings of Takkar (1969) and Barbaria and Patil (1980). The reason attributed by them for the decrease in the available Fe content at 60th day of incubation was due to the imbalance of the nutrient besides the interaction of the micronutrient with the major nutrients at the 45th day. Among the treatments, the application of FYM 10 t + $FeSO_4$ 50 kg/ha was found to be superior in increasing the Fe availability followed by the application of FYM 10 t + pyrite 700 kg/ha.

While comparing the treatments with respect to the soil, it was noticed that, the treatment FYM 10 t + pyrite 700 kg/ha in black calcareous

Table 2. Incubation experiments - Availability of Iron in soil at different periods in ppm DTPA Fe

	Period															
	1st day		3rd day		7th day		15th day		30th day		45th day		60th day		Mean	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control	2.60	2.62	2.55	2.83	2.92	3.44	3.12	3.65	3.48	4.81	3.42	5.20	2.83	4.24	3.1	3.8
$FeSO_4$ 50 kg/ha	2.60	2.44	3.60	2.90	3.80	3.63	4.98	3.96	6.22	4.98	8.82	7.68	5.24	5.20	5.0	5.4
Pyrite 700 kg/ha	2.12	2.20	2.40	2.60	3.20	3.00	3.60	3.20	4.20	3.82	7.26	4.40	10.81	5.65	4.8	3.6
FYM 10 t/ha	2.27	2.46	2.57	2.81	3.60	3.82	4.80	5.10	5.62	5.84	8.26	7.98	6.68	5.12	4.8	4.7
FYM 10 t/ha + $FeSO_4$ 50 kg	3.40	3.62	3.62	3.89	3.84	4.22	5.86	6.22	8.84	9.44	9.88	11.42	7.84	10.82	6.2	7.1
FYM 10 t/ha + Pyrite 700 kg/ha	2.38	2.42	2.66	2.53	3.45	3.02	4.22	3.38	9.83	4.98	12.47	5.68	15.89	8.89	7.3	7.1
Mean	2.	2.55	2.93		3.49		4.34		6.00		7.71		7.43			

	SE(D)	C.D.
Period	0.658	1.312
Treatment	0.571	1.140
Soil x Treatment	0.807	1.610

S_1 = Black calcareous soil

S_2 = Red non-calcarous soil

and FYM 10 t + $FeSO_4$ 50 kg/ha in red non-calcareous soil (S_2) were significantly superior in increasing the available Fe content. The values being 7.27 and 7.09 ppm DTPA Fe respectively. The high availability of Fe due to the application of FYM + $FeSO_4$ 50 kg/ha (soil) in the case of red non-calcareous soil could be attributed to the formation of metal ion complexes due to the solubilization of Fe by the humic and fulvic acids present in the FYM (Table 2).

Similarly, the increased availability of Fe due to the application of FYM + pyrite was attributed to the chelating effect of FYM, thus releasing the Fe. The results obtained were in agreement with the findings of Vlek and Lindsay (1978).

The curve depicting the Fe availability in both the soils indicates the pattern of availability of Fe measured as DTPA-Fe at different periods of incubation which varied significantly by the Fe treatments in both soils.

In black calcareous soil (S_1) application of pyrite with FYM increased the DTPA-Fe content by five times compared to control after an incubation period of two months, while in red-non-calcareous soil (S_2) $FeSO_4$ 50 kg + FYM increased the Fe availability. The favourable influence of pyrite plus FYM application towards the Fe availability might be due to the release of Fe adsorbed on $CaCO_3$. This could be possible due to the release of H_2SO_4 during the degradation of pyrite which might be responsible for the dissolution of $CaCO_3$ with the reduction in the pH of the soil.

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