

EVALUATION OF CRITICAL LIMIT OF IRON IN ARIDISOLS FOR WHEAT

V. K. GUPTA AND B. S. POTALIA

Department of Soil Science, Haryana Agricultural University, Hisar

ABSTRACT

The DTPA extractable Fe in 19 surface soils of arid region of Haryana, ranged from 1.4 to 6.4 ppm. A response of less than 10 per cent was obtained in 42 per cent soils while 58 per cent soils gave a response of more than 10 per cent. Soils having less than 3.2 ppm DTPA extractable Fe were highly responsive to Fe application. Bray's per cent yield ranged from 44.5 to 103.7 and was significantly and positively correlated with DTPA Fe ($r = 0.75$). The critical DTPA extractable Fe concentration in soil below which wheat will respond to Fe application was found to be 4.0 ppm.

INTRODUCTION

Some soils of arid region may be subjected to Fe deficiency due to alkaline reaction, low organic matter, high CaCO_3 and light texture of soil. Gupta and Associates (1988) reported that 42% soils of arid region of Haryana could be classified as Fe-deficient. Critical limit of Fe below which economical responses are obtained may vary considerably with soil and test crops. There is hardly any information available on the critical limit of Fe in soils for wheat crop in Aridisols. In the absence of critical limit, it is not feasible to identify soils deficient and adequate in Fe content. Therefore, the present investigation was envisaged to work-out the critical limit of available Fe in Aridisols for wheat crop.

MATERIAL AND METHODS

Nineteen surface soils (0-15 cm) belonging to the Aridisols group were collected. DTPA extractable iron in soil was determined by the method described by Lindsay and Norvell (1978). For important soil properties the methods as described by Chopra and Kanwar (1976) were used. The texture of these soils ranged from sand to sandy loam, pH from 7.4 to 8.8, organic carbon from 0.12 to 0.55%, EC from 0.08 to 0.85 dSm^{-1} , CaCO_3 from traces to 6.5%. The DTPA extractable Fe ranged from 1.4 to 6.4 ppm. Four kilogram, air-dried soil was filled in polyethelene lined earthen pots with three levels of Fe, viz., 0, 10 and 20 ppm as ferrous sulphate, alongwith basal dose of 100 ppm N, 50 ppm P and K each, 5 ppm Zn and 10 ppm Mn as urea, diammonium phosphate, muriate of potash, zinc sulphate and manganese sulphate respectively, in all the pots in solution form. All the treatments were replica-

ted thrice. Wheat variety WH-147 was grown till maturity and grain yield was recorded. Deionized water was used for raising the crop.

$$\text{Bray's per cent yield was calculated as : } \frac{\text{Yield without Fe application}}{\text{Yield with 20 ppm Fe}} \times 100$$

RESULTS AND DISCUSSION

Response to Fe

Grain yield of wheat ranged from 16.2 to 25.7 g/pot in control (Table 1), varying with available iron. Mean values indicated that grain yield increased markedly at 10 ppm Fe while at 20 ppm Fe the increase was marginal when compared with 10 ppm Fe. Application of 20 ppm Fe suppressed the yield in some soils when compared with that of 10 ppm Fe. Bray's per cent yield at 20 ppm Fe in most of the soils was less than 100, which indicated that majority of the soils responded to Fe application. The results further revealed (Table 2) that 42 per cent soils gave a response to less than 10 per cent and the mean value of DTPA-Fe in these soils was 5.3 ppm with a range of 4.0 to 6.4 ppm. The soils giving a response of 10 to 20 and greater than 20 were 42 and 16 per cent respectively, with a mean value of 3.6 and 2.26 ppm DTPA-extractable-Fe. The low response of wheat to Fe application despite the low soil Fe, indicated that wheat could be considered a comparatively resistant crop to Fe stress (Gupta and Potalia 1987).

Critical concentration of Fe in soils

Brays' per cent yields were calculated and regressed on DTPA extractable-Fe. The resulting equation $Y=60.67 + 6.37 x$, Y represents Brya's per cent yield and x DTPA extractable Fe. Grapical representation of Brays' per cent yield of wheat grain (Fig. 1) against DTPA extratable-Fe by the method of Cate and Nelson (1965) and a critical level of 4.0 ppm DTPA extractable-Fe with a prediction value (R^2) of 0.56-separated the responsive from the non-responsive soils. Soils having less than 2.26 ppm DTPA extractable Fe could be classifield as highly responsive to Fe application. The coefficient of correlation between Brays' per cent yield and DTPA extractable-Fe was significant and positive ($r=0.75$) which corroborated that response of wheat to Fe is highly dependent on DTPA extractable-Fe in soil. The results are in close proximity with those of Lindsay and Norvell (1978); Gupta and Potalia (1987) who reported 4.5 ppm DTPA extractable-Fe as the critical limit for sorghum. The results pointed out that wheat in Aridisols having lower than 4.0 ppm DTPA extractable-Fe should be fertilized with Fe to get optimum yield.

Table 1. Physico-chemical characteristics and response of Fe to wheat in Aridisols

Soil No.	Fe levels (ppm)			DTPA, Fe (ppm)	Bray's %	O.C. (%)	Texture	CaCO ₃ (%)	pH (1:2)
	0	10	20						
	grain yield (g/pot)			yield					
1	23.6	25.3	26.4	3.2	89.4	0.15	1s	0.2	8.4
2	15.1	17.6	17.4	3.2	87.1	0.12	s	0.5	7.5
3	25.2	26.7	28.0	3.6	89.3	0.20	1s	Nil	7.7
4	19.1	23.0	25.5	2.8	78.0	0.16	1s	6.0	8.8
5	23.2	24.1	25.0	4.8	92.9	0.40	1s	6.5	8.5
6	24.6	25.5	26.9	6.4	91.4	0.56	1s	1.5	7.4
7	17.1	18.5	19.0	3.6	90.0	0.12	1s	0.9	8.0
8	19.8	22.7	22.7	2.8	87.4	0.16	1s	5.0	8.5
9	18.6	19.3	20.6	4.4	90.6	0.23	1s	0.1	7.6
10	16.7	20.1	21.7	2.6	77.0	0.18	s	1.7	8.3
11	15.7	35.2	35.3	1.4	44.5	0.17	1s	2.0	8.1
12	18.1	19.8	21.2	4.0	91.4	0.13	s	2.5	8.6
13	20.1	24.5	23.2	6.4	103.7	0.20	1s	4.7	8.5
14	19.8	20.6	20.2	6.0	98.0	0.15	s	4.7	8.4
15	24.3	26.5	29.0	3.8	83.7	0.15	1s	2.5	8.4
16	21.2	21.9	24.6	5.6	86.0	0.40	s1	Nil	8.5
17	19.4	19.5	20.8	5.6	94.0	0.36	s1	Nil	7.4
18	16.2	18.8	19.4	3.2	83.8	0.21	1s	2.5	8.1
19	23.0	23.9	24.8	5.2	95.8	0.26	1s	1.0	8.6
Mean	20.8	22.8	24.2						

C.D. 5% : Fe levels 0.98

Table 2. Response of wheat to Fe fertilization

Pre cent response	No. of soils	Per cent of total	DTPA Fe (ppm)	
			Range	Mean
up to 10	8	42	4.0-6.4	5.30
10-20	8	42	2.8-5.6	3.60
Above 20	3	16	1.4-2.8	2.26

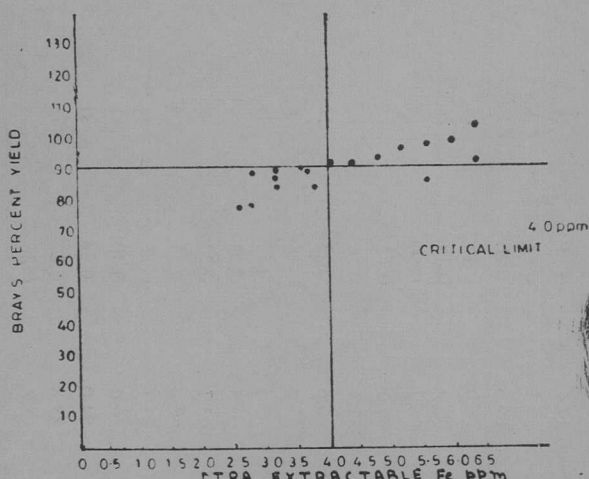


FIG. 1. RELATIONSHIP BETWEEN DTPA EXTRACTABLE Fe AND BRAY'S PERCENT YIELD OF WHEAT GRAIN

REFERENCES

- Cate, R.B. and Nelson, L.A. 1965. Tech. Bull. Int. Soil testing services. 1. North Carolina State Univ. Agric. Exp. Sta. Raleigh.
- Chopra, S.L. and Kanwar, J.S. 1976. Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana.
- Gupta, V.K. and Potalia, B.S. 1987. Determination of critical limit of Fe in soil for predicting response of sorghum to Fe application in Aridisols. Annals of Arid Zone 26 : 139-143.
- Gupta, V.K. and Associates 1988. Annual progress report of all India coordinated scheme of micronutrient, secondary nutrient and pollutant elements in soils and plants.
- Lindsay, W.L. and Norvell, W.A. 1978. Development of DTPA test for zinc, iron, manganese and copper. Soil Science Society of America Proceedings 42: 421-428.