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# Response and Uptake of Iron by Sorghum to Application of Iron, Farmyard Manure and Sulphur in Calcareous Soil

**C. J. Babaria and C. L. Patel**

Department of Agricultural Chemistry and Soil Science Gujarat Agricultural University, Junagadh.

Inspite of large amount of total iron present in soil, only a fraction of this is available to crop plants either due to unfavourable soil physical conditions or interactions with elements present in soil. This total reserve of iron can be made available to crop plants by application of organi c/matter (Mann *et al.*, 1978), sulphur (procopiou *et al.* 1976) as well as application of iron compounds (Srivastava *et al.*, 1977). The present investigation was initiated to study the response of hybrid sorghum CSH-5 (*Sorghum bicolor* (L.) Moench) to application of different levels of iron, sulphur and FYM on highly calcareous soil of Saurashtra region of Gujarat. The S and FYM and their combinations were selected to know their effect on release of available iron from native total Fe of soil.

Field experiment was conducted on University Farm, Junagadh during the period of July-November, 1977-78. The soil used in experiment was medium black, clay in texture having pH 8.4, $CaCo_3$ 42%, total Fe 2.01% and available Fe 1.02 ppm. The fertilizers were applied at the rate of 120 kg N/ha in form of urea and diammonium phosphate, 60 kg $P_2O_5$/ha in form of diammonium phosphate and 60 kg $K_2O$/ha in form of potassium chloride. The nitrogen was given in two splits.

Ten treatment combinations were used. Iron was applied at the rate of 10, 20 and 30 ppm in form of $FeSO_4$, $7H_20$. Farmyard manure was applied at the rate of 5 and 10 tonne/ha. The FYM was collected from cow-dung manure pit which contained total N 0.98 per cent, total $P_2O_5$, 1.15 per cent and total $K_20$ 0.7 per cent. Elemental sulphur was applied at the rate of 20 and 40 ppm. The combination of FYM + sulphur ($F_5S_{20}$) and Fe + FYM + S ($Fe_{10}F_5S_{20}$) were also studied. The amendments and Fe were applied in furrow before sowing. There was also an absolute control.

The experiment was laid out in completely randomised block design with four replications. Crop was harvested and grain and fodder yields were recorded separately on oven dry basis (60°C for 24 hours). The roots of four representative plants from each plot were dug out, washed and oven dried. Grain, fodder and root samples were ground separately and digested using 10:1:4 volume ratio of concentrated $HNO_3$, concentrated $H_2SO_4$ and 60 per cent $HClO_4$, respectively (Jackson, 1967). Iron was determined by orthophenanthroline method (Hesse, 1971).

Application of iron @ 10 ppm increased the grain and fodder yield but failed to attain the level of significance

*TABLE I*

**Effect of application of iron, FYM and sulphur on yield and concentration and uptake of Fe by hybrid sorghum.**

| | *Treatments* | *Yield of hybrid sorghum kg/ha (oven dried)* | | *Concentration of Fe, ppm* | | | *Uptake of Fe, g/ha* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Grain* | *Fodder* | *Root* | *Shoot* | *Grain* | *Shoot* | *Grain* | *Total* |
| 1. | $Fe_0F_0S_0$ | 2811.1 | 5597.1 | 390.62 | 109.37 | 85.93 | 608.75 | 241.75 | 850.50 |
| 2. | $Fe_{10}$ | 3121.3 | 6215.2 | 542.96 | 132.81 | 97.65 | 826.00 | 296.25 | 1122.25 |
| 3. | $Fe_{20}$ | 3688.0 | 6944.4 | 652.34 | 140.62 | 121.09 | 921.50 | 445.25 | 1366.75 |
| 4. | $Fe_{30}$ | 3419.0 | 6336.5 | 714.93 | 171.87 | 144.53 | 1088.00 | 497.00 | 1585.00 |
| 5. | $F_5$ | 3708.7 | 9006.8 | 564.27 | 156.25 | 128.90 | 1405.00 | 478.50 | 1883.50 |
| 6. | $F_{10}$ | 3132.7 | 8874.9 | 476.78 | 113.93 | 97.65 | 1007.00 | 300.50 | 1308.00 |
| 7. | $S_{20}$ | 3186.1 | 7791.6 | 492.18 | 132.81 | 101.56 | 953.00 | 322.00 | 1275.00 |
| 8. | $S_{40}$ | 3073.00 | 6944.4 | 445.31 | 140.62 | 93.74 | 985.75 | 287.50 | 1273.25 |
| 9. | $F_5S_{20}$ | 3337.6 | 6648.8 | 460.93 | 136.71 | 109.37 | 913.25 | 362.25 | 1275.50 |
| 10. | $Fe_{10}F_5S_{20}$ | 3390.7 | 7834.6 | 519.53 | 140.62 | 117.18 | 1103.25 | 395.50 | 1498.75 |
| 11. | S. Em. ± | 158.26 | 253.54 | 21.37 | 8.06 | 7.25 | 61.38 | 26.53 | 73.46 |
| 12. | C.D. at 5% | 459.20 | 683.42 | 62.01 | 23.39 | 21.05 | 179.00 | 76.97 | 213.14 |

Subscript numbers indicate levels of application.

(Table 1). When the level of iron was raised to 20 ppm, there was increase in the grain yield by 31 per cent over the yield of 2811 kg/ha from the control. The highest level of iron (30 ppm) failed to differ significantly from $Fe_{20}$ and $Fe_{10}$ levels; but its yield was significantly higher than the yield obtained under the control. Thus, the optimum dose of Fe turned out to be 20 ppm. Such increase was also noted in the case of fodder yield. Response of soil applied iron was expected because of low availability of Fe in high ly calcareous soil used in the present experiment. The reports of Srivastava *et al.* (1977) and Chapman and Boundy (1977) also showed that the application of iron increased the yield of different crops. The highest grain and fodder yields of 3708 and 9006 kg/ha, respectively, were obtained by addition of FYM @ 5 t/ha. Higher level of FYM @ 10 t/ha did not help in increasing the grain and fodder yields but there was reduction compared to $F_5$ level. It is known that organic matter increased the availability of iron (Mann *et al.* 1978) on calcareous soil. Working with soil used in present experiment, Babaria and Patel (1980) also observed significant increase in availability of iron, by application of FYM.

Application of elemental S @ 20 ppm did not affect the grain yield but significantly increased the fodder yield over the control. Higher level of S @ 40 ppm slightly decreased the fodder yield compared to level of 20 ppm of S. The combined application of FYM and S as well as Fe, FYM and S significantly increased the grain yields by 18 and 20 per cent, respectively, over the yield obtained under control. Both combinations were also found superior in producing the fodder yield.

The increase in rate of application of iron, significantly increased the concentration of iron in root, shoot and grain (Table 1). The concentration deviation between root and shoot and shoot and grain increased with increase in levels of application of iron. Thus, the amount of iron absorbed by the root was not translocated to shoot and grain proportionately with increase in levels of iron. The total uptake of iron also significantly increased with application of different levels of iron. Such higher concentration of iron and uptake by sorghum due to application of iron may be owing to readily available iron from $FeSO_4$, $7H_2O$. The increase in uptake of iron was also reported by Srivastava *et al.* (1977) by application of iron.

Addition of FYM@ 5 t/ha significantly increased the iron content in root, shoot and grain over control. But higher dose of FYM @ 10 t/ha materially decreased the content of iron in root, shoot and grain compared to lower level of FYM, probably due to formation of organo-metallic complexes which difficultly release iron in soil. The maximum uptake of iron was obtained under the treatment of 5 t/ha of FYM owing to maximum total yield produced by this treatment. Application of FYM on calcareous soil increased the availability of iron (Mann *et al.* 1978) which could have increased the concentration and uptake of iron in sorghum.

Sulphur applied @ 20 ppm increased the concentration of iron in root and shoot significantly over the control but failed to attain the levels of significance in the case of grain. The higher levels of sulphur significantly

increased the concentration of iron only in shoot. Significant increase in uptake of iron was obtained by application of 20 ppm S. Addition of S in soil converted to $H_2SO_4$ by microflora and decreased the soil pH. Consequently the availability of Fe increased in soil. Procopiou *et al.* (1976) also observed that application of S on calcareous soil increased the concentration of iron in *Phaseolus vulgaris* L.

The combined application of FYM and S and Fe, FYM and S significantly increased the concentration of iron in root, shoot and grain as well as total uptake of iron over the control.

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