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# INTEGRATED EFFECT OF IRON AND FYM ON YIELD AND UPTAKE OF NUTRIENTS IN WHEAT

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## ABSTRACT

*A field experiment was conducted on a sandy loam soil at Bichpuri (Agra) during rabi season 2008-10 to study the effect of Fe (0, 10, 20 and 40 kg Fe ha$^{-1}$) and FYM (0, 2.5, 5.0 and 10.0 t ha$^{-1}$) levels on yield and uptake of nutrients by wheat. Application of 20 kg Fe ha$^{-1}$ increased significantly the grain and straw yield and the uptake of nutrients by the crop. Likewise, addition of FYM also significantly enhanced the yields and uptake of N, P, K and Fe by the grain and straw of wheat, Iron and FYM showed a synergists effect on uptake of nutrients and ultimately on the grain and straw yield of wheat. Maximum grain and straw yields were obtained in the treatment where 20 kg Fe was applied with 10 t FYM ha$^{-1}$. Protein percentage and yield also increased significantly with iron and FYM application*

**Keywords:** Iron, FYM, yield, uptake, nutrients, wheat

## INTRODUCTION

The advent of high yielding wheat varieties, frequent use of high levels of fertilizers and irrigation has resulted in to increased cropping intensity and crop productivity in India. In the areas of intensive cropping, application of micronutrients is almost ignored that leads to imbalance in the nutrient management. Among the micronutrient cations, iron has been noted to be a limiting element other than zinc in alkaline soils as its deficiency is being observed on several crops. Substantial amounts of soluble iron in such soils get converted in to unavailable form. Farmyard manure is a complete food for crops including Fe with wide ranging benefits. Application of FYM in soil helps in increasing the fertility of the soil as well as the physical condition including its water holding capacity. Thus, the integrated use of Fe and farmyard manure improves the availability of Fe in soils and plays a significant role in improving quality and seed development. The response of wheat to iron application has earlier been reported by other workers (Kulandaivel et al, 2003 and Chandel 2010). Yet, integrated effect of iron and farmyard manure on performance of quality and crop productivity in Agra has remained uninvestigated. Keeping these facts in view, the present study was undertaken to evaluate the integrated effect of iron and FYM on yield of wheat.

## MATERIALS AND METHODS

Field experiments were conducted during Rabi 2008-10 on alluvial soil with wheat at R.B.S. College, farm Bichpuri, Agra (U.P). The soil had pH 8.1, 3.8 g kg$^{-1}$ organic carbon, 140 kg available N ha$^{-1}$, 8.5 kg available P ha$^{-1}$, 110 kg available $K_2O$ ha$^{-1}$ and 4.2 mg kg$^{-1}$ DTPA-Fe. The experiment was laid out in randomized block design with three replications. The treatments included four levels each of FYM (0, 2.5, 5.0 and 10.0 t ha$^{-1}$) and Fe (0, 10, 20 and 40 kg ha$^{-1}$). A basal dose of 150 kg N, 60 kg $P_2O_5$ and 60 kg $K_2O$ were applied at the time of sowing through urea, diammonium phosphate and muriate of potash, respectively. The Fe was applied at the time of final land preparation through ferrous sulphate. The FYM was incorporated in to the soil 15 days prior to sowing of wheat. The crop was harvested at maturity and grain and straw yields were recorded. Grain and straw samples were digested in di-acid mixture ($HNO_3$ and $HClO_4$) and analysed for P by vanadomolybdate yellow colour method, K by flame photometer and iron by atomic absorption spectrophotometer. Nitrogen content in grain and straw was determined by Kjeldahl method (Jackson 1973). Protein content in wheat grain was computed by multiplying the percentage of nitrogen with 6.25.

## RESULTS AND DISCUSSION

A perusal of data (Table 1) revealed that the application of graded doses of Fe to wheat significantly enhanced the grain and straw yield over control. Highest grain (53.02 q ha$^{-1}$) and straw (67.48 q ha$^{-1}$) yield was recorded with the application of 20 kg Fe ha$^{-1}$ over rest of the treatments. The response to Fe in this soil may be due to low available Fe status of the soil. Similar results were reported by Singh *et al.* (2002) and Yadav et al. (2007). Application of 10 t

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FYM ha$^{-1}$ increased the grain and straw yield of wheat to the tune of 15.5 and 16.0 % over control, respectively. The beneficial effect of FYM may be due to its contribution in supplying additional plant nutrients, improvement of soil physical condition and biological process in soil (Dahiya *et al.* 1987). However, better improvement in yield was exhibited when Fe and FYM were integrated together. Among the different integrated practices, significantly highest grain and straw yield were recorded when 20 kg Fe ha$^{-1}$ was integrated along with FYM either @ 10 or 5 t ha$^{-1}$. This increase might be due to steady decomposition of FYM and release of nutrients throughout the crop growth period coupled with better assimilation of nutrients (Kumar *et al.* (2008). These findings indicate that the combined application of Fe and FYM is superior to sole application of either Fe or FYM. Such beneficial effects of integrated use of FYM with chemical fertilizers confirmed the findings of Singh *et al.* (2002) and Yadav *et al.* (2007).

Table 1: Effect of iron and FYM application on yield, content and protein yield in wheat

| Iron (kg ha$^{-1}$) | FYM (t ha$^{-1}$) | | | | | FYM (t ha$^{-1}$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 2.5 | 5.0 | 10 | Mean | 0 | 2.5 | 5.0 | 10 | Mean |
| | Grain yield (q ha$^{-1}$) | | | | | Straw yield (q ha$^{-1}$) | | | | |
| 0 | 42.50 | 46.80 | 49.42 | 49.66 | 47.09 | 55.25 | 60.37 | 64.29 | 64.80 | 61.18 |
| 10 | 45.60 | 50.00 | 52.96 | 53.10 | 50.42 | 58.37 | 64.00 | 67.78 | 68.49 | 64.66 |
| 20 | 48.76 | 52.95 | 55.05 | 55.32 | 53.02 | 61.92 | 67.24 | 69.97 | 70.80 | 67.48 |
| 40 | 47.55 | 51.82 | 55.00 | 55.00 | 52.34 | 60.39 | 65.69 | 69.85 | 69.05 | 66.24 |
| Mean | 46.10 | 50.39 | 53.11 | 53.27 | | 58.98 | 64.32 | 67.97 | 68.28 | |
| CD (P=0.05) | Fe 2.20 FYM 2.20 Fe x FYM 4.40 | | | | | Fe 2.50 FYM 2.50 Fe x FYM 5.00 | | | | |
| | Protein content (%) in grain | | | | | Protein yield (kgha$^{-1}$) in grain | | | | |
| 0 | 13.4 | 14.7 | 15.6 | 16.2 | 14.9 | 569.5 | 687.9 | 770.9 | 804.5 | 708.2 |
| 10 | 14.1 | 15.0 | 16.4 | 16.9 | 15.6 | 642.9 | 750.0 | 868.5 | 897.4 | 789.7 |
| 20 | 15.0 | 15.6 | 16.6 | 17.2 | 16.1 | 731.4 | 826.0 | 913.8 | 951.5 | 855.7 |
| 40 | 15.0 | 15.9 | 16.6 | 17.9 | 16.3 | 713.2 | 823.9 | 913.0 | 984.5 | 858.6 |
| Mean | 14.4 | 15.3 | 16.3 | 17.1 | | 664.2 | 771.9 | 866.5 | 909.5 | |
| CD (P=0.05) | Fe 0.55 FYM 0.55 Fe x FYM 1.10 | | | | | Fe 10.12 FYM 10.12 Fe x FYM 20.24 | | | | |

The content and yield of protein in wheat grain increased significantly with Fe levels over control (Table 1). This increase may be attributed to increased N content and grain and straw yields with Fe application. Similar results were reported by Chandel (2010). Application of FYM increased the content and yield of protein in grain from 14.4 % and 664.2 kg ha$^{-1}$ in the control to 11.1 % and 909.5 kg ha$^{-1}$ with 10 t FYM ha$^{-1}$, which may be due to greater grain and straw production. The combined effect of Fe and FYM on content and yield of protein was significant. The maximum values of content (17.9 %) and yield (984.5 kg ha$^{-1}$) of protein was in grain which received 40 kg Fe and 10 t FYM ha$^{-1}$ being superior to all other combination of the two.

The uptake of nitrogen by wheat crop increased significantly with lower levels of iron addition followed by a reduction at 40 kg Fe ha$^{-1}$. The increase in N uptake with lower level of iron may be due to higher grain and straw production. Singh et al. (2002) and Chandel (2010) also reported similar results. Organic matter addition proved beneficial as much as it increased the N uptake by wheat crop significantly. The maximum N uptake values were recorded under 10 t FYM ha$^{-1}$. This increase in N uptake by FYM is obvious as it is considered as a store house of plant nutrients especially of nitrogen. Higher uptake of N with FYM indicates that mineralized N from FYM could sufficiently meet the nutritional requirement of the crop. Dahiya *et al.* (1987) also reported similar results. The interaction between Fe and FYM was significant and maximum values of N uptake by wheat crop were recorded under 10 t FYM + 20 kg Fe ha$^{-1}$ treatment.

The utilization of P by wheat grain and straw increased significantly with lower levels of Fe over control. The higher level of iron (40 kg Fe ha$^{-1}$) caused a significant reduction in P uptake by wheat crop over 20 kg Fe ha$^{-1}$. This reduction may be due to reduction in grain and straw production with 40 kg Fe ha$^{-1}$. Similar results were reported by Chahal *et al.* (1979) and Chandel (2010). The utilization of P by wheat crop registered a significant increase as the amount of added FYM increased. The maximum average values of P uptake by wheat grain and straw were recorded with 10 t FYM ha$^{-1}$. This increase in P

uptake with FYM levels seems to be associated with increased P availability from applied FYM with a concomitant increased P uptake by wheat crop. Singh and Dahiya (1980) reported an increased uptake of P with FYM addition. The interaction effect of iron and FYM on P uptake by wheat crop was significant (Table 2). The maximum value of P uptake by wheat crop was noted under combined application of 20 kg Fe $ha^{-1}$ and 10 t FYM $ha^{-1}$.

Table 2: Effect of iron and FYM application on uptake of nutrients in wheat grain and straw

| Iron (kg $ha^{-1}$) | Grain | | | | | Straw | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FYM (t $ha^{-1}$) | | | | | FYM (t $ha^{-1}$) | | | | |
| | 0 | 2.5 | 5.0 | 10 | Mean | 0 | 2.5 | 5.0 | 10 | Mean |
| | | | | | Nitrogen (kg $ha^{-1}$) | | | | | |
| 0 | 91.4 | 109.9 | 123.5 | 129.1 | 113.5 | 28.7 | 36.2 | 41.8 | 45.4 | 38.0 |
| 10 | 102.6 | 120.0 | 138.7 | 143.4 | 126.2 | 32.1 | 40.3 | 44.1 | 49.3 | 41.4 |
| 20 | 117.0 | 132.4 | 145.9 | 152.1 | 136.8 | 37.1 | 43.7 | 50.3 | 51.7 | 45.7 |
| 40 | 114.1 | 132.1 | 146.3 | 151.0 | 136.1 | 36.8 | 43.3 | 46.6 | 51.8 | 45.5 |
| Mean | 106.3 | 123.6 | 138.6 | 144.1 | | 33.7 | 40.9 | 46.6 | 49.5 | |
| CD (P=0.05) | | Fe 4.10 | FYM 4.10 | Fe x FYM 8.20 | | | Fe 2.19 | FYM 2.19 | Fe x FYM 4.38 | |
| | | | | | Phosphorus (kg $ha^{-1}$) | | | | | |
| 0 | 13.6 | 15.9 | 17.8 | 18.4 | 16.4 | 5.5 | 7.2 | 8.3 | 8.4 | 7.3 |
| 10 | 15.0 | 17.5 | 20.1 | 20.7 | 18.3 | 6.4 | 7.7 | 8.8 | 8.5 | 7.8 |
| 20 | 16.6 | 19.6 | 21.5 | 22.1 | 19.9 | 7.4 | 8.7 | 9.8 | 10.6 | 9.1 |
| 40 | 15.2 | 18.1 | 20.3 | 21.4 | 18.7 | 6.6 | 7.2 | 8.4 | 8.9 | 7.8 |
| Mean | 15.1 | 17.8 | 19.9 | 20.6 | | 6.5 | 7.7 | 8.8 | 9.1 | |
| CD (P=0.05) | | Fe 0.69 | FYM 0.69 | Fe x FYM 1.38 | | | Fe 0.11 | FYM 0.11 | Fe x FYM 0.22 | |
| | | | | | Potassium (kg $ha^{-1}$) | | | | | |
| 0 | 21.7 | 25.7 | 28.7 | 29.3 | 26.3 | 104.9 | 117.7 | 129.9 | 134.8 | 121.8 |
| 10 | 23.7 | 29.0 | 31.8 | 32.9 | 29.3 | 112.6 | 126.7 | 138.9 | 143.8 | 130.5 |
| 20 | 26.8 | 30.2 | 33.6 | 35.4 | 31.5 | 121.4 | 134.5 | 144.8 | 150.1 | 137.7 |
| 40 | 24.7 | 28.5 | 31.3 | 31.9 | 29.1 | 115.9 | 128.1 | 139.7 | 140.9 | 131.5 |
| Mean | 24.2 | 28.3 | 31.3 | 32.4 | | 113.7 | 126.7 | 138.3 | 142.4 | |
| CD (P=0.05) | | Fe 3.20 | FYM 3.20 | Fe x FYM 6.40 | | | Fe 4.15 | FYM 4.15 | Fe x FYM 8.30 | |
| | | | | | Iron (g $ha^{-1}$) | | | | | |
| 0 | 265.6 | 301.8 | 328.6 | 347.6 | 310.9 | 607.7 | 676.1 | 739.3 | 754.9 | 694.5 |
| 10 | 303.5 | 345.0 | 373.4 | 384.9 | 352.2 | 665.4 | 745.6 | 799.8 | 821.9 | 758.2 |
| 20 | 346.2 | 383.9 | 412.9 | 428.7 | 392.9 | 733.7 | 806.9 | 857.1 | 874.4 | 818.0 |
| 40 | 361.4 | 401.6 | 437.2 | 448.2 | 412.1 | 748.8 | 824.4 | 890.6 | 890.7 | 838.6 |
| Mean | 319.7 | 358.1 | 388.0 | 402.3 | | 688.9 | 763.2 | 821.7 | 835.5 | |
| CD (P=0.05) | Fe 19.35 | FYM 19.35 | Fe x FYM 38.70 | | | | Fe 27.15 | FYM 27.15 | Fe x FYM 54.30 | |

The K uptake by wheat grain and straw increased significantly and consistently up to 20 kg Fe $ha^{-1}$. Thereafter, a reduction in potassium uptake by wheat crop was noted at 40 kg Fe $ha^{-1}$. Dahiya et al. (1987) and Chandel (2010) also reported similar results. The addition of FYM proved beneficial and increases in K uptake by grain and straw due to 10 t FYM $ha^{-1}$ over control were 33.8 and 25.2 %, respectively. A further increase in K uptake was recorded with the combined addition of FYM and Fe and maximum value of K uptake by grain (35.4 kg $ha^{-1}$) and straw (150.1 kg $ha^{-1}$) were noted under 20 kg Fe + 10 t FYM $ha^{-1}$.

The Fe uptake by wheat grain and straw increased significantly with increasing levels of Fe over control (Table 2) which may be due to increased availability of Fe in soil. Chandel (2010) reported similar results in oat. The addition of FYM also increased the uptake of Fe by wheat crop. In grain, Fe uptake ranged from 319.7 (control) to 402.3 g $ha^{-1}$ (10 t FYM $ha^{-1}$) and in straw it was from 688.9 to 835.5 g $ha^{-1}$. The higher uptake of Fe due to FYM may be due to higher grain and straw yield. The maximum uptake of Fe was obtained with combined application of 40 kg Fe and 10 t FYM $ha^{-1}$ treatments. This increase may be attributed to increase in grain and straw yield. Thus, the alkaline soils are responsive to Fe and the efficiency of applied Fe may be enhanced by mixing the iron with FYM before adding to soil. Similar results were reported by Singh *et al.* (2002).

On the basis of results, it is concluded that individual and combined application of Fe and FYM gave significant beneficial effect on seed and straw yield of wheat. The yields recorded with the application of 20 kg Fe along with 10 t FYM $ha^{-1}$ were statistically superior to all the other treatment combinations. The uptake of nutrients was also influenced by Fe and FYM application.

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