INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2003/05–4–608–610
http://www.ijab.org

Iron Requirement of Barani Wheat

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ABSTRACT

Iron requirement of barani wheat was investigated through a farmer field experiment near Jhelum in Rawalpindi division during 1999-2000. The Fe levels (kg ha^{-1}) tried were 0, 5, 10, 15 and 20. The data revealed that wheat crop responded significantly to added Fe and 20 kg Fe ha^{-1} appeared to be the optimum dose for conditioning barani wheat yield under this experimental condition. The agronomic efficiency (SNR/GNR) reduced with subsequent increase in Fe application level.

Key Words: Barani wheat; Fe requirement; Grain yield; Agronomic efficiency; MRR; Predicted yield

INTRODUCTION

Wheat (*Triticum aestivum*) is the most important food crop in the world including Pakistan. It is grown in winter on large areas of all the four provinces of Pakistan (Anonymous, 1998). The fast growing population of the country makes it imperative to achieve matching increase in the rate of food production. Nutrient stress in ours soils and crops are on the increase. The main reason for this is that nutrient removal far exceed nutrient addition, resulting nutrient balances in the soil bank are negative. This situation has rendered most of the soils deficient in essential plant nutrient. Resultantly the present fertility status of the soils cannot sustain high yield.

Fertilizer is a kingpin in enhancing wheat production and on the average one kg of nutrient produces 10 kg cereal grain (FAO, 1981). But on the other hand yield has been leveled off in spite of increased NPK application (IPI, 1984). The reason appears to be imbalance use of NPK and almost no use of micronutrient particularly Fe to wheat crop. Micronutrients may be one of the constraints responsible for low and uneconomical agriculture production in the country. New strategies and technologies for increase in crop production have to be developed through proper soil-water-fertilizer-plant management practices. Fe is one of the most important elements essential for plant growth. Fe is essential for chlorophyll formation. It is an essential component of many enzymes. Iron also enters in to oxidation process that release energy from sugars and starches and reaction that convert nitrate to ammonium in plant. It plays an essential role in nucleic acid metabolism. The sufficiency range of iron in plant tissue is normally between 50 and 250 ppm. Iron deficiency is likely to occur when Fe contents are 50 ppm or less in the dry matter (Nisar *et al*., 1996).

Munawar (1990) reported that out of 132 point soil samples from different area of NWFP, 1.5% were deficient in Fe. Rashid and Rafique (1988) reported that out of 140 soil samples from Jhelum, 3% were deficient in Fe. Although very little deficiency of Fe is noticed in normal soils but several factors can cause deficiencies of micronutrients including imbalance of nutrient in soil, unfavorable physico-chemical condition of soil.

The wheat crop has been reported to respond to micronutrients substantially (Tahir *et al*., 1981). At NIFA, Tarnab 5 kg of Fe ha^{-1} gave an increase of 14% in wheat grain (Wisal *et al*., 1990). At Kalor Saidan 10 kg of Zn + 1 kg of B+5 kg of Cu +10 kg of Mn + 10 kg of Fe ha^{-1} increased the grain yield by 26.1% (Rashid *et al*., 1987) and 40.6% (Rashid & Rafique, 1988). At Faisalabad, 5 kg of Zn ha^{-1} + 2.5 kg of Fe ha^{-1} increased the wheat grain yield by 10.9% and 5 kg of Zn ha^{-1} + 2.5 kg of B ha^{-1} + 10 kg of Fe ha^{-1} increased the yield by 11.3% (Alam *et al*., 1988). As little information is available regarding Fe requirement of barani wheat crop, the present study was, therefore, undertaken to assess optimum dose of Fe for conditioning barani wheat crop.

MATERIALS AND METHODS

The study was carried out on farmer field near Jhelum in Rawalpindi Division during 1999-2000 under barani condition. The levels of Fe tried were 0, 5, 10, 15 and 20 kg ha^{-1}. A basal dose of N - P_2O_5 - K_2O (150-120-90) through urea, DAP and potassium sulphate was applied in all treatments and mentioned levels of Fe from iron sulphate in respective treatments were applied at the time of sowing (6.11.99). The experiment was laid out in randomized complete block design with three replicates. The variety Chakwal-86 was planted on 8.11.99. A total of six rains (53 mm) were received by the experiment from 12th January to 3rd March, 2000.The yield data were recorded on 26.4.2000 by harvesting randomly selected 3x3 m from each treatment on 16.4.2000 and were statistically analyzed by using analysis of variance techniques. The differences among treatments were compared by LSD at $P_{0.05}$ (Steel & Torrie, 1980). The soil samples from the experiment sites were collected before sowing and analysed in the laboratory for physical and chemical characteristics by standards methods. Soil characteristics of the experiment site are given in Table I.

Table I. Soil characteristics of experimental site

Soil parameter	Mean value
EC (dS m^{-1})	0.30
PH	7.8
Organic matter (%)	0.70
Available-P (mg kg^{-1})	4.5
Available-K (mg kg^{-1})	130
Textural class	Loam

RESULTS AND DISCUSSION

Wheat response to Fe. Wheat straw yield responded significantly to Fe application (Table II). The straw yield increased with increase in Fe rate application. The increase of straw by iron application is in agreement with those of Baranwal and Verma (1995), Mehra and Shekawat (1999), Negm and Zahram (2001), Ziaeian and Malakouti (2001), Asad and Rafique (2002) and Singh *et al.* (2002). The higher rate of Fe application (20 kg ha^{-1}) gave 8976 kg ha^{-1} straw yield (18.4% increases) against 7584 kg ha^{-1} by control (no Fe). Statistically Fe application @ 15 and 20 kg ha^{-1} produced almost identical yield. The agronomic efficiency (SNR) reduced with subsequent increase in Fe. The reduction of agronomic efficiency was also reported by Pervaiz *et al.* (2003), with the subsequent increase of Zn.

Wheat grain yield significantly increased to Fe application (Table III). The grain yield increased with increase in Fe rate application. The increase in grain yield by iron application is in line with those reported by Rashid *et al.* (1987), Rashid and Rafique (1987-88), Wisal *et al.* (1990), Baranwal and Verma (1995), Dahdoh *et al.* (1999) Mehra and Shekawat (1999), Moussa (2000), Negm and Zahran (2001), Ziaeian and Malakouti (2001), Asad and Rafique (2002) and Singh *et al.* (2002). Wisal *et al.* (1990) reported that 5 kg Fe ha^{-1} increased 14% grain yield but in our study, 10 kg Fe ha^{-1} increase the grain yield by 14%. Less increase in case of this study as compared to the Wisal *et al.* (1990) might be due to the barani condition and less moisture content of soil. Ziaeian and Malakouti (2001) reported that 10 kg ha^{-1} Fe increase the grain by 11%. The higher rate of Fe application (20 kg ha^{-1}) gave 5244 kg ha^{-1} grain yield (20.8% increase) against 4340 kg ha^{-1} by control (no Fe). The agronomic efficiency (GNR) reduced with subsequent increase in Fe level. The reduction of agronomic efficiency was also reported by Rehman *et al.* (2001) and Pervaiz *et al.* (2003).

Fe requirement. Based on regression line derived from the data predicted values for different rate of Fe along with economics of Fe application are presented in Table IV. The data showed quadratic trend with 23 kg Fe ha^{-1} as the

Table II. Wheat straw yield response to Fe application

Fe rate (kg ha^{-1})	Straw yield(kg ha^{-1})	% increase	Straw Nutrient Ratio (SNR)
0	7584 d	-	-
5	7939 c	4.7	71
10	8443 b	11.3	86
15	8657 ab	14.2	72
20	8976 a	18.4	70

Cd_1 = 348

Table III. Wheat grain yield response to Fe application

Fe rate (kg ha^{-1})	Grain yield (kg ha^{-1})	% increase	Grain Nutrient Ratio (GNR)
0	4340 d	-	-
5	4666 c	7.5	65
10	4948 b	14.0	61
15	5044 b	16.2	47
20	5244 a	20.8	45

Cd_1 = 109.78

Table IV: Predicted response and economics of Fe application to barani wheat. (Y= 4348. 6286 + 68.7486 x – 1. 2514 x^2)

Fe rate (kg ha^{-1})	Predicted yield (kg ha^{-1})	Net return (Rs)	Value Cost Ratio (VCR)	Grain Nutrient Ratio (GNR)
0	4349	-	-	-
5	4661	2140	11.7	62
10	4911	3815	10.54	56
15	5098	5018	9.36	50
20	5223	5755	8.19	44
At Economic Optimum Rate (MRR-1)*				
23	5268	5973	7.49	40

***MRR = Marginal Rate of Return. Prices per kg = wheat Rs. 7. 50 and Fe Rs. 40.00**

optimum rate for barani wheat based on MRR-1. Since actual yield produced by 23 kg Fe ha^{-1} is non-significant to yield released by 20 kg Fe ha^{-1} (Table IV), therefore, this rate i.e., 20 kg Fe ha^{-1} appeared to be the optimum dose for conditioning barani wheat yield. . Net return at 20 kg ha^{-1} Fe is Rs. 5755 and VCR is 8.19. This 20 kg ha^{-1} Fe (costing Rs. 800) and net return amounting to Rs. 5755 and VCR 8.19 is quite encouraging. Before concluding the exact quantity of Fe for barani wheat it should be kept in mind that this experiment received six rains (53 mm) which ultimately increased the efficiency of Fe application. More research is needed to authenticate the Fe requirement of barani wheat.

Acknowledgement. The authors are grateful to Mr. Khalid Mehmood Mughal, Statistical Officer for his assistance in statistical work.

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(Received 02 July 2003; Accepted 19 September 2003)