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Zinc Requirement of Barani Wheat

Zahid Pervaiz, [1]Khadim Hussain, S.S.H.Kazmi and [2]Mrs.Belqees Akhter
Soil and Water Testing Laboratory, Gujrat, Pakistan
[1]Soil and Water Conservation Research Institute, Chakwal, Pakistan
[2]Pesticide Quality Control Laboratory, Kala Shah Kaku, Pakistan

Abstract: Zinc requirement of barani wheat was investigated through a farmer field experiment near Jhelum in Rawalpindi division during 1999-2000. The Zn levels (Kg ha^{-1}) tried were 0, 2.5, 5.0, 7.5 and 10.0. The data revealed that wheat crop responded significantly to added zinc and 7.5 Kg Zn ha^{-1} appeared to be the optimum dose for conditioning barani wheat yield under experimental condition. The agronomic efficiency [Straw nutrient ratio/ Grain nutrient ratio (SNR/GNR)] reduced with subsequent increase in Zn application level. More research is needed to authenticate the Zn requirement of barani wheat.

Key words: Barani wheat, Zn levels, Zn 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, 1998b). 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 can not 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 Zn to wheat crop. Zinc is one of the most important elements essential for plant growth (Russel, 1961). Due to continual removal from the soil, deficiency of Zn in crops has been widely noticed (Tahir, 1978) resulting in severe reduction in their yields (Taker and Randhawa, 1978; Tahir, 1978). Field experiments in the Punjab have established wide spread deficiency of Zn in wheat (Tahir, 1981; PARC, 1986).It conduced towards Zn fertilization of soils to restore crop yields (Tahir, 1978; Takkar and Randhawa, 1978; Lindsay, 1972; Ahmad *et al.*, 1996).

Zinc deficiency is a major micronutrient disorder in alkaline calcareous soils of Pakistan (Anonymous, 1998) and elsewhere (Takkar and Walker, 1993) because of availability and high Zn fixation (Lindsay, 1979). Memon (1985-86) reported that out of 100 soil samples from Badin, 44% were deficient and 44% of soils were marginal in Zn. Munawar, (1990) reported that out of 132 point soil samples from different area of NWFP, 83% were deficient in Zn. Kausar *et al.*, (1979) reported that out of 151 soil samples, 86% of the soils were deficient in Zn in all the four provinces of Pakistan. Rashid and Rafique (1987-88) reported that out of 140 soil samples from Jhelum, 54% were deficient in Zn.

Sillanpaa (1982) found that out of 242 soils sampled, 62% of those in the Punjab, 100% in Sindh and 77% in NWFP were deficient in Zinc. The wheat crop has been reported to respond to micronutrients substantially (Tahir *et al.*, 1981). At Mansehra 10 Kg Zn ha^{-1} increased the grain yield of wheat by 5%, 61% at D.I.Khan, 49% at Tarnab and 13% at Bannu (Annual Report, 1979-80, 1981-82). At different sites of Kasure in Lahore division 10 Kg Zn ha^{-1} increased the wheat grain yield by 12.6% (Rehman *et al.*, 2001).

As little information is available regarding zinc requirement of barani wheat crop, the present study was, therefore, undertaken to assess optimum dose of zinc 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 Zn (Kg ha^{-1}) tried were 0, 2.5, 5.0, 7.5 and 10.0. 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 Zn in respective treatments were applied at the time of sowing (9.11.99). The experiment was laid out in randomized complete block design. The variety Inqlab-91 was planted on 11.11.99. A total of six rains were received by the experiment on 12th and 13th January, 1st, 9th and 10th February and 3rd March, 2000.The yield data were recorded by harvesting randomly selected 3x3 m from each treatment on 19.4.2000 and were statistically analyzed by using analysis of variance techniques. The differences among treatments were compared by LSD at $P_{0.05}$ (Steel and 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 1.

Results and Discussion

Wheat response to zn: Wheat straw yield responded significantly to Zn application (Table 2). The straw yield increased with increase in Zn rate application. The higher rate of Zn application (10 Kg ha^{-1}) gave 9183 Kg ha^{-1} straw yield against 7333 Kg ha^{-1} by control (no Zn). The agronomic efficiency (SNR) reduced with subsequent increase in Zn level up to 7.5 Kg ha^{-1} and then increased at 10 Kg Zn ha^{-1} application.

Wheat grain yield significantly increased to Zn application (Table 3). The grain yield although increased with increase in Zn rates but this increase was significantly different only up to 7.5 Kg Zn ha^{-1} application. The agronomic efficiency (GNR) reduced with subsequent increase in Zn level. The increase in yield with Zn application is in line with those reported by Hadi *et al.* (1997) and Rehman *et al.* (2001).

Table 1: Soil characteristics of experimental site

Soil parameter	Mean value
EC (dS m^{-1})	0.35
pH	7.8
Organic matter (%)	0.60
Available-P (mg Kg^{-1})	4.0
Available-K (mg Kg^{-1})	130
Textural class	Loam

Table 2: Wheat straw yield response to Zn application

Zn rate (Kg ha^{-1})	Straw yield (Kg ha^{-1})	% increase	Straw Nutrient Ratio (SNR)
0	7333 d	-	-
2.5	8124 c	10.8	316
5.0	8620 b	17.6	257
7.5	8650 b	18.0	176
10.0	9183 a	25.2	185

Cd_1 = 431

Table 3: Wheat grain yield response to Zn application

Zn rate (Kg ha^{-1})	Grain yield (Kg ha^{-1})	% increase	Grain Nutrient Ratio (GNR)
0	4251 c	-	-
2.5	4651 b	9.4	160
5.0	4784 b	12.5	107
7.5	4977 a	17.1	97
10.0	5066 a	19.2	82

Cd_1 = 154.8

Table 4: Predicted response and economics of zinc application to barani wheat ($Y= 4274.3143 + 142.4686\,x - 6.4229\,x^2$)

Zn rate (Kg ha^{-1})	Predicted yield (Kg ha^{-1})	Net return (Rs)	Value Cost Ratio (VCR)	GrainNutrient Ratio (GNR)
0	4274	-	-	-
2.5	4590	2170	11. 85	126
5.0	4826	3740	10. 35	110
7.5	4982	4710	8. 85	94
10.0	5057	5073	7. 34	78
At Economic Optimum Rate (MRR-1)*				
9. 4	5046	5038	7. 70	82

• MRR = Marginal Rate of Return, • Price of wheat= Rs. 7.5/ Kg, • Price of Zn= Rs. 80 / Kg

Zn Requirement: Based on regression line derived from the data predicted values for different rate of Zn along with economics of Zn application are presented in Table 4. The data showed quadratic trend with 9.4 Kg Zn ha^{-1} as the optimum rate for barani wheat based on MRR-1. Since actual yield produced by 10 Kg Zn ha^{-1} is non-significant to yield released by 7.5 Kg Zn ha^{-1} (Table 3), therefore, this rate i.e., 7.5 Kg Zn ha^{-1} appeared to be the optimum dose for conditioning barani wheat yield whereas Rehman *et al.* (2001) reported 5 Kg Zn ha^{-1} for irrigated wheat yield. High requirement of Zn under barani wheat might be due to the the low moister content of soil under barani condition as compared to irrigated wheat where 5 Kg Zn ha^{-1} appeared to be the optimum dose for conditioning wheat yield (Rehman *et al.*, 2001).

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