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Original Research Article

Effect of Zinc and Sulphur Fertilization on Growth, Yield and Economics of Wheat Crop

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Keywords

Zinc, sulphur, wheat, yield attibutes, economics

A B S T R A C T

A field experiment was conducted during the *rabi* season of 2016-17 at College of Agriculture, Ganjbasoda on sandy loam soil, to assess the effect of zinc and sulphur nutrition on wheat. Six treatments were evaluated in randomized block design with three replications. All the growth and yield attributing characters were affected significantly by different treatments. Treatment of TURBO ZS @ 10.00 kg/ha with fertis @ 7.50 kg/ha produced maximum grain yield which was significantly superior over all the treatments. The maximum gross and net monetary return was obtained from TURBO ZS @ 10.00 kg/ha with fertis @ 7.50 kg/ha.

Introduction

National food security is an important issue and wheat has pivotal role in ensuring food security of the country. Wheat is the most important staple food grain in Indian diet and main source of protein and calories for large section of population. By 2020, India will have a substantial pressure on land to produce more food. Stagnation in wheat production, lower productivity and inferior quality of the produce is due to various constraints including inadequate and imbalanced nutrient application (Prasad, 2012).

The growth and yield of plant is determined by the availability of some specific mineral nutrients that are absolutely essential for the completiton of their life cycle (Marshner, 1995). The application of these essential nutrients to plants in the form of chemical fertilizers is necessary for intensive agriculture. Zinc is an essential micronutrient for plant growth and is absorbed by the plant roots in the form of Zn^{2+}. It is involved in diverse metabolic activities, influences the activities of hydrogenase and carbonic anhydrase, synthesis of cytochrome and the stblisation of ribosomal fraction and auxin metabolism (Tisdale *et al.*, 1984). Due to deficiency of zinc, plants exhibits poor growth, interveinal chlorosis and necrosis of lower leaves. Reddish or brownish spot often occurs on the older leaves and ultimately seed production is strikingly reduced due to its deficiency (Thorne, 1957). Sulphur

deficiency can exert a large influence on the technological properties of wheat (Randall and Wrigley, 1986; Zhao *et al.*, 1999).

Materials and Methods

The field experiment was conducted in *rabi* season at College of Agriculture, Ganjbasoda during 2016-17 to evaluate the effect of zinc and sulphur fertilization on growth and yield of wheat crop. The experiment site is situated at 23^0 85' N Latitude, 77^0 92' E longitude and 399 meters above the mean sea level. Weather conditions like rainfall, maximum and minimum temperature ranges during the crop growth period (October- march) were 0 mm, 23.1 to 39.5^{o}C and 8.1 to 21.7^{o}C, respectively. The soil of experimental field was sandy loam in texture, 176 kg in available N, 8.04 kg in available P and 303 kg in available K contents, 0.40% organic carbon, 7 (1:2.5 soil and water ratio) soil pH and 0.83 ds/m soil EC based on the standard methods for their determination. Six treatments viz. T_1- TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha, T_2- TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha, T_3- Zinc sulphate @ 12.50 kg/ha, T_4- TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) 7.50 kg/ha, T_5- Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha and T_6- untreated control were tested in randomized block design with three replications. Crop received recommended dose of 120 kg N, 60 kg P_2O_5 and 40 kg K_2O through urea, di-ammonium phosphate and muriate of potash. One-third dose of N and full dose of P and K were applied as basal. Remaining two-third N was given in two equal split at the time of first and second irrigation. Zinc and sulphur were applied through TURBO ZS, zinc sulphate and fertis, respectively, as per the treatments. All the treatments were applied at the time of sowing except fertis application and it is was applied as top dressing at 20 days after sowing. Wheat 'HI 1544' was sown in rows, 25 cm apart using 100 kg seeds/ha in the first week of November. Other agronomic management practices were followed as per the standard recommendation. The crop was harvested at maturity and grain and straw yields were recorded. The economics of wheat production was worked out on the basis of prevailing market price of different inputs and final produce.

Results and Discussion

Growth and yield attributes

All the growth and yield attributing characters were affected significantly by different treatments. Among all the treatments, TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha and TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha produced significantly taller plants than rest of the treatments (Table 1). It is obvious from the data of Table 1 that number of effective tillers/m^2 was significantly minimum (332.5) under untreated control, whereas, maximum was noted under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha which were at par to TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha, TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha and Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha. Data on ear length as influenced by different treatments reveal that ear length significantly varied due to treatments (Table 1). Maximum ear length (9.56 cm) was found under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha which was at par to TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha, TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha.

Table.1 Influence of treatments on plant height and yield attributing characters

Treatments	Plant height at harvest(cm)	Effective tillers/m^2	Ear length (cm)	No. of grains/ear	Weight of grains/ear (g)	1000 grains weight (g)
T_1- TURBO ZS @ 10.00 kg/ha	93.5	389.0	9.27	46.5	2.73	48.37
T_2- TURBO ZS @ 12.50 kg/ha	97.8	392.5	9.39	49.7	2.89	49.80
T_3- $ZnSO_4$ @ 12.50 kg/ha	94.3	361.5	8.98	43.4	2.48	47.37
T_4- TURBO ZS @ 10.00 kg/ha + Fertis @ 7.50 kg/ha	97.2	396.5	9.56	48.0	2.82	50.18
T_5- $ZnSO_4$ @ 12.50 kg/ha + Bentonite @ 25.00 kg/ha	92.4	382.5	9.04	46.1	2.61	48.12
T_6- Untreated control	90.6	332.5	8.43	37.3	2.37	43.29
SEm±	0.84	5.53	0.17	0.79	0.09	0.77
CD (p= 0.05)	2.65	17.37	0.54	2.47	0.29	2.43

Table.2 Influence of treatments on grain and straw yield and harvest index

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T_1- TURBO ZS @ 10.00 kg/ha	52.92	77.74	40.50
T_2- TURBO ZS @ 12.50 kg/ha	55.12	79.82	40.84
T_3- $ZnSO_4$ @ 12.50 kg/ha	44.17	65.63	40.22
T_4- TURBO ZS @ 10.00 kg/ha + Fertis @ 7.50 kg/ha	59.76	82.66	41.96
T_5- $ZnSO_4$ @ 12.50 kg/ha + Bentonite @ 25.00 kg/ha	47.67	68.10	41.17
T_6- Untreated control	41.17	62.48	39.72
SEm±	0.93	2.24	-
CD (p= 0.05)	2.91	4.98	-

Table.3 Influence of treatments on economics

Treatments	Total cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit-cost ratio
T_1- TURBO ZS @ 10.00 kg/ha	34014	105990	74976	3.12
T_2- TURBO ZS @ 12.50 kg/ha	34314	110315	79001	3.21
T_3- $ZnSO_4$ @ 12.50 kg/ha	33439	88517	58078	2.65
T_4- TURBO ZS @ 10.00 kg/ha + Fertis @ 7.50 kg/ha	34764	119330	87566	3.43
T_5- $ZnSO_4$ @ 12.50 kg/ha + Bentonite @ 25.00 kg/ha	34439	95340	60901	2.77
T_6- Untreated control	32814	82597	52783	2.52

Treatment of TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha led to record the maximum number of grains/ear (49.7) which was significantly higher than all treatments except TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha (48.0). It is evident from the data given in Table 1 that weight of grains/ear significantly influenced by the various treatments. Untreated control plot led to record the minimum weight of grains/ear (2.37) which was at par to Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha and Zinc sulphate @ 12.50 kg/ha. Maximum 1000- grains weight (test weight) was noted under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S)@ 7.50 kg/ha which was at par to TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha, TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha and Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha, while untreated control plot recorded significantly lowest test-weight.

Data pertaining to grain yield (q/ha) as affected by different treatments are given in Table 2. Grain yield significantly varied due to different treatments. All the treated plots significantly produced higher grain yield than untreated control plot. Treatment of TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha produced maximum grain yield (59.76 q/ha) which was significantly superior over all the treatments. The next best treatment was TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha and it was at par to TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha.. Dewal and Pareek (2004) opined that wheat fertilized with Zn and sulphur improved the nutritional environment of rhizosphere, which resulted in greater uptake of nutrients by the crop and this caused higher metaboloic and photosynthetic activity in plant leading to higher yield. Untreated control treatments produced the lowest grain yield. Khan *et al.*, (2007) in an experiment on wheat and rice using two levels of zinc (5 and 10 kg/ha) reported an increase in the number of tillers, spike/m^2, spike length, plant height and 1000 grain weight of wheat significantly, over control. Likewise, Razvi *et al.*, (2005) recorded significantly higher grain yield, straw yield, harvest index and dry matter production at harvesy by the application of zn, over the rest of the treatments. All treated plots produced significantly higher straw yields than untreated control except Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha and Zinc sulphate @ 12.50 kg/ha (Table 2). Straw yield was higher under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) 7.50 kg/ha closely followed by TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha and TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha. Harvest index values did not differ due to different treatments. The values ranged from 39.72 under untreated control to 41.96 per cent under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) 7.50 kg/ha.

Economics

Untreated control treatment needed the lowest cost of cultivation (Rs. 32814/ha) and it increased under all treated plots according to cost of fertilizers and the charges of their application (Table 3). It ranged from Rs. 33439 to Rs. 34764/ha under different fertilizers treatments. The value of grain and straw yields depending on the existing market rate under each treatment was taken into consideration to determine the gross monetary return (GMR) of the particular treatment. The GMR was lower (Rs. 82597/ha) under treatment of untreated control which remarkably increased under all treated plots. The value was higher **(**Rs. 119330/ha**)** under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S)

@ 7.50 kg/ha. The net monetary return (NMR) for each treatment was determined by subtracting the cost of cultivation from the GMR of the same treatments. The treatment wise value thus, obtained are given in Table 2. It is clear from the data that NMR was minimum (Rs. 52783/ha) under treatment of untreated control closely followed by Zinc sulphate @ 12.50 kg/ha (Rs. 58078/ha). The maximum NMR was obtained from TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha was Rs. 87566/ha. The benefit-cost indices as affected by various treatments are given in table 2. It is evident from the data that the value was maximum (3.43) under TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha with fertis (90 % S) @ 7.50 kg/ha closely followed by TURBO ZS (15% Zn + 70% S) @ 12.50 kg/ha (3.21) and TURBO ZS (15% Zn + 70% S) @ 10.00 kg/ha (3.12). The value was minimum (2.52) under untreated control closely followed by Zinc sulphate @ 12.50 kg/ha (2.65) and Zinc sulphate @ 12.50 kg/ha with bentonite @ 25.00 kg/ha (2.77).

References

Dewal, G.S. and Pareek, R.G. 2004. Effect of phosphorous, sulphur and zinc on growth, yield and nutrient uptake of wheat (*Triticum aestivium* L.). Indian J. Agron. 49: 160-162.

Khan, R., Gurmani, A.R., Khan, M.S. and gurmani, A.H. 2007. Effect of zinc application on rice yield under rice wheat system. Pakistan J. Biol. Sci. 10:235-239.

Marshner, H. 1995. Mineral nutrition of higher plants. 2nd edition p 889, Academic Press, London

Prasad, R. 2012. Fertilizers and manures. Current Science 102 (6):894-898.

Randall, P.J. and Wrigley, C.W. 1986. Effects of sulphur supply on the yield, composition and quality of grain from cereals, oilseeds and legumes. Advances in Cereal Sci. technol. 8:171-206.

Razvi, M.R., Halepyati, A.S., Pujari, B.J. and Koppalkar, B.G. 2005. Influence of graded levels of fertilizers applied to green manure and wheat on biomass production of sunhemp and grain yield of wheat under irrigation. Karnataka J. Agric. Sci. 18:4-7.

Thorne, D.W. 1957. Zic deficiency and its control. Adv. Agron. 9:31-65.

Tisdale, S.L., Nelson, W.L. and Beaten, J.D. 1984. Zinc. *In*: Soil fertility and fertilizers. 4th edition pp 382-391, Macmillan Publishing Company, New York, USA.

Zhao, F.J., Hawkesford, M.J. and McGrath, S.P. 1999. Sulphur assimiliation and effects on yield and quality of wheat. J. Cereal Sci. 30:19-31.