



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

© Agronomy

www.agronomyjournals.com

2024; SP-7(12): 4-6

Received: 07-09-2024

Accepted: 09-10-2024

JP Jadeja

Department of Agronomy,
Junagadh Agricultural University,
Junagadh, Gujarat, India

KV Ram

Department of Agronomy,
Junagadh Agricultural University,
Junagadh, Gujarat, India

AR Ninama

Department of Agronomy,
Junagadh Agricultural University,
Junagadh, Gujarat, India

SD Chudasama

Department of Agronomy, Navsari
Agricultural University, Navsari,
Gujarat, India

BP Solanki

Department of Agronomy,
Junagadh Agricultural University,
Junagadh, Gujarat, India

Effect of zinc and iron fortification on growth and yield of wheat (*Triticum aestivum* L.)

JP Jadeja, KV Ram, AR Ninama, SD Chudasama and BP Solanki

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i12Sa.2085>

Abstract

A field experiment entitled “Bio fortification of wheat (*Triticum aestivum* L.) through foliar application of iron and zinc” was carried out under medium black clayey slightly alkaline soil in reaction with pH 8.1 and EC 0.50 ds/m during *rabi* 2019 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The experimental results revealed that significantly higher values of growth parameters viz., Number of total tillers/plant and yield attributes viz., Number of effective tillers/plant and 1000-seed weight along with higher seed yield and straw yield were recorded with increasing foliar spray of iron and zinc.

Keywords: Growth, yield, zinc and iron

Introduction

Wheat (*Triticum aestivum* L.) is number one cereal of the world and being grown on the largest area. In India, wheat is the second most important food crop next to rice and it contributes nearly 35 per cent to the national food basket. Its contribution to the green revolution is significant. Among winter cereals, it contributes about 49 percent of food grain production. During the year 2020-21, wheat was grown over an area of 34.42 million ha with a production of 102.69 million tonnes with an average productivity of 3384 kg/ha.

India ranks second after China in wheat growing countries. Wheat is cultivated in almost all the states of India, but its extensive cultivation is confined to Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Rajasthan, Bihar and Gujarat which produce 31.88, 15.91, 17.85, 11.16, 9.19, 5.74 and 3.10 million tonnes, respectively. In India Uttar Pradesh leads in area and total production, Punjab leads in productivity. While Gujarat occupies an area of 1.09 million hectares with a production of 3.79 million tonnes and productivity of 2979 kg/ha (Anon., 2020) [3]. In Gujarat, wheat is being cultivated under irrigated as well as rain fed conditions.

Zinc plays significant role in various enzymatic and physiological activities of plant. Zinc is an essential micro nutrient required for growth and development of the higher plants (Kochian, 1993 and Marschner, 1995) [7, 9] and is involved in membrane integrity, enzyme activation and gene expression (Kim *et al.*, 2002) [6].

Iron plays a role in the formation of plant chlorophyll. Iron-containing plant haemoglobins are another promising target for altering Fe content in plant-based foods. Plant haemoglobin is similar to the human haemoglobin, with Fe binding capacity and is most commonly found in nodulating *legumes* (nitrogen fixing plants) (Kundu *et al.*, 2003) [8].

Bio fortification is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding or modern biotechnology. Bio fortification differs from conventional fortification in that bio fortification aims to increase nutrient levels in crops during plant growth rather than through manual means during processing of the crops. Agronomic approaches such as application of Zn and Fe containing fertilizers appear to be rapid and simple solution to address the Zn and Fe deficiency in crop and human health. Agronomic fortification with foliar application of micronutrients particularly zinc and iron not only increase the yield but also nutrient quality of pearl millet for obtaining good economic return and also nutritional security. So, enrichment of pearl millet with zinc and iron fortification is one of the option to improve the quality.

Corresponding Author:

JP Jadeja

Department of Agronomy,
Junagadh Agricultural University,
Junagadh, Gujarat, India

Materials and Methods

The field experiment was conducted during *rabi* season of 2019-20 at Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh (Gujarat), which is situated in South Saurashtra Agroclimatic region of Gujarat state and enjoys a typically subtropical climate characterized by fairly cold and dry winter, hot and dry summer as well as warm and moderately humid monsoon. Which is situated at 21.5° N latitude and 70.5° E longitudes with an altitude of 60 m above the mean sea level. The soil was clayey in texture and slightly alkaline in reaction with pH 7.9 and EC 0.33 dS/m. The soil of the experimental site was medium in available nitrogen (277 kg/ha), available phosphorus (27.02 kg/ha), available potassium (279.55 kg/ha), medium in available zinc (0.65 ppm) and medium in available iron (5.53 ppm). The soil was free from any kind of salinity or sodicity hazards.

The experiment was conducted with eighteen treatment combinations of two varieties GW 190 and GW 463 comprising three levels each of iron (Control, FeSO₄ @ 1.0% at heading stage, FeSO₄ @ 1.0% at heading & milking stage) and zinc (Control, ZnSO₄ @ 0.5% at heading stage, ZnSO₄ @ 0.5% at heading & milking stage). These treatments were evaluated under factorial randomized block design with three replications. The crop was sown at 22.5 cm spacing on 27th November and recommended dose of fertilizer was 120-60-60 N-P-K kg/ha and all other recommended practices were adopted according to as per needed of crop requirement. The crop was harvested at physiological maturity on March 11, 2020. The growth and yield attributes were recorded from the five tagged plants in each plot. Seed and stover yield were recorded from the net plot area and

converted into kilogram per hectare base.

Results and Discussion

Effect of variety

An evident of data (Table 1) indicated that effect of variety had no significant effect on number of total tillers, number of effective tillers per meter row length, 1000 seed weight, seed yield and straw yield.

Effect of iron

It is apparent from data in Table 1 indicated that the increasing foliar spray of iron significantly increased the number of total tillers per plant as well as number of effective tillers per plant and 1000-seed weight. Seed and straw yields also increased significantly up to FeSO₄ @ 1.0% at heading & milking stage. Application of FeSO₄ @ 1.0% at heading & milking stage registering highest seed yield (4947 kg/ha) and stover yield (7231 kg/ha). This might be due to iron role in starch formation and protein synthesis as well as maintenance and synthesis of chlorophyll in plants. The increased in the availability of iron to plant might have stimulated the metabolic and enzymatic activities thereby increasing the growth of the crop. Similar findings were also reported by Yadav *et al.*, (2013). Iron provides potential for many of the enzymatic transformations. Several of these enzymes are involved in chlorophyll synthesis, grain formation and dry matter production, which ultimately lead to final yield characters such as number of effective tillers per plant. These findings are in confirmation to the earlier reported by Gupta *et al.*, (2002)^[5] and Abbas *et al.*, (2009)^[12].

Table 1: Growth and yield as influenced by different iron and zinc applications

Treatments	Number of total tillers/meter row length	Number of effective tillers/meter row length	1000-grain weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Varieties (V)					
V ₁ : GW 190	82.49	68.12	41.31	4629	6388
V ₂ : GW 463	83.22	71.1	43.12	4866	6763
S.E.m.±	1.25	1.26	0.63	93	95
C.D. at 5%	NS	NS	NS	NS	NS
Foliar spray of iron (Fe)					
Fe ₀ : Control (Water spray)	74.23	64.63	40.02	4530	6502
Fe ₁ : FeSO ₄ @ 1.0% at heading stage	85.88	70.51	42.99	4765	7013
Fe ₂ : FeSO ₄ @ 1.0% at heading and milking stage	88.45	73.69	43.62	4947	7231
S.E.m.±	1.53	1.54	0.77	115	117
C.D. at 5%	4.41	4.44	2.22	330	336
Foliar spray of zinc (Zn)					
Zn ₀ : Control (Water spray)	77.66	63.94	40.23	4528	6475
Zn ₁ : ZnSO ₄ @ 0.5% at heading stage	83.33	71.46	42.90	4770	6989
Zn ₂ : ZnSO ₄ @ 0.5% at heading and milking stage	87.57	73.43	43.51	4944	7267
S.E.m.±	1.53	1.54	0.77	115	117
C.D. at 5%	4.41	4.44	2.22	330	336
Interaction (Fe × Zn)	NS	7.69	NS	NS	NS
Interaction (V × Fe)	NS	NS	NS	NS	NS
Interaction (V × Zn)	NS	NS	NS	NS	NS
Interaction (V × Fe × Zn)	NS	NS	NS	NS	NS
C.V.%	7.86	9.41	7.76	10	10

Effect of zinc

The perusal of data presented in Table 1 revealed that the increasing foliar spray of zinc significantly increased the number of total tillers per plant as well as number of effective tillers per plant and 1000-grain weight. Seed and stover yields are increased significantly up to ZnSO₄ @ 0.5% at heading & milking stage. Application of ZnSO₄ @ 0.5% at heading & milking stage registering highest grain yield (4944 kg/ha) and

straw yield (7267 kg/ha). Zn plays important role in synthesis of various enzymes like carbonic anhydrase, glutamic acid dehydrogenase, lactic acid dehydrogenase and some peptidases. It is also considered to be precursor for auxin synthesis involved in nitrogen metabolism and several oxidation-reduction reactions, stability of RNA and starch formation thus its adequate supply results higher dry matter production, ultimately growth and development of plants (Dadhich and Gupta, 2003)^[4].

Parallel results were also established by Abbas *et al.*, (2016)^[1]. The increased in the yield attributes might also be due to role of zinc in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordia for reproductive parts and partitioning of photosynthates towards them (Wear and Hagler, 1968)^[11], which might have been resulted in better flowering and fruiting. This finding is in conformation to the earlier reports of Singaravel *et al.*, (2001)^[10].

Acknowledgments

The authors are grateful to the Director, College of Agriculture, Junagadh Agricultural University for providing necessary field and laboratory facilities during M.Sc. research work.

On the basis of the results of the one year field study, it can be concluded that higher production from wheat variety GW 463 can be secured by foliar application of FeSO₄ @ 1.0% and ZnSO₄ @ 0.5% at heading & milking stage in medium black calcareous soil of South Saurashtra Agro-climatic zone.

References

1. Abbas A, Safdar ME, Ali A, Asif M, Rehman A. Effect of foliar application of zinc at different growth stages on grain yield and quality of wheat (*Triticum aestivum* L.). J Environ Agric. 2016;1(2):106-11.
2. Abbas G, Khan MQ, Khan MJ, Hussain F, Hussain I. Effect of iron on the growth and yield contributing parameters of wheat (*Triticum aestivum* L.). J Anim Plant Sci. 2009;19(3):135-9.
3. Anonymous. District wise area, production, yields of major crops of Gujarat State. Gandhinagar: Directorate of Agriculture, Government of Gujarat; 2020.
4. Dadhich LK, Gupta AK. Productivity and economics of pearl millet fodder as influenced by sulphur, zinc and planting pattern. Forage Res. 2003;28(4):207-9.
5. Gupta PK, Sharma NN, Acharaya HK, Gupta SK, Mali GS. Response of mungbean to zinc and iron on Vertisols of South-Western Plains of Rajasthan. National Symposium on Arid Legumes for Food Security and Promotion Trade, October 2002. Sponsored by Indian Arid Legumes Society, CAZRI, Jodhpur; 2002.
6. Kim T, Harry AM, Hazel YW. Studies on the effect of zinc supply on growth and nutrient uptake in pecan. J Plant Nutr. 2002;25:1987-2000.
7. Kochian LV. Zinc absorption from hydroponic solution by plant roots. In: Zinc in soils and plants. Kluwer Publishers; 1993. p. 45-57.
8. Kundu S, Trent JT, Hargrove MS. Plants, humans and hemoglobins. Trends Plant Sci. 2003;8:387-93.
9. Marschner H. Mineral Nutrition of Higher Plants. 2nd ed. London: Academic Press; 1995.
10. Singaravel R, Imayavaramban Y, Dhanunathan K, Shanmughapriya N. Response of sesame (*Sesamum indicum*) to manganese and zinc nutrition. J Oilseeds Res. 2001;18:136-8.
11. Wear JI, Hagler TB. Plant food review. Spring; 1968.