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Effect of iron and zinc enriched organics on nutrient content and uptake by wheat in loamy sand

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Abstract
A field experiment was carried at the Agronomy Instructional Farm, Department of Agronomy, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the effect of iron and zinc enriched organics on nutrient content and uptake of wheat in loamy sand (Typic *Ustisamments*) during *rabi* season of 2017-18. The results revealed that the concentration of N in grain and straw was increased significantly due to an application of 5 t FYM ha^{-1} and 2 t VC ha^{-1} along with recommended dose of fertilizer (RDF) but remain at par with application of either 5t FYM ha^{-1} or 2 t VC ha^{-1} along with RDF. However, significantly higher content of Fe and Zn by grain and straw and uptake of N, P, Fe and Zn by grain and straw of wheat were obtained by application of vermicompost @ 0.2 t ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn along with RDF as compared to control (RDF).

Keywords: Iron, zinc, FYM, vermicompost, wheat

Introduction
Micronutrient deficiencies in Indian soils and crops have been on the increase since the adoption of modern agricultural technology with increased use of NPK fertilizers generally free from micronutrients, intensive cultivation with fertilizer responsive improved varieties of crops with more irrigation facilities, limited use of organic manure and restricted recycling of crop residues (Prasad, 1999) [4].

The deficiencies of micronutrients have become major constraint for maintaining productivity of soil. Analysis of about 2.5 lakh soil samples in different states of India carried out under the All India Co-ordinated Research Project on Secondary and Micronutrients and Pollutant Elements in Soils and Plants has revealed that 48, 12, 5 and 3 per cent soils were deficient in cationic micronutrients such as Zn, Fe, Mn and Cu, respectively (Singh, 2006) [6]. Physical mixture of fertilizer with organic is supposed to be inferior compared to the addition of micronutrients to the soil in naturally chelated form with organics. The process of enrichment of organics with micronutrients has drawn attention of soil scientists as the enrichment not only improves the nutrient use efficiency, but also helps in reducing the load of inorganic chemicals as well as quantity of organics to considerable extents. The enrichment technique improves the quality of organics and therefore the addition of organics in lower quantities is expected to yield the similar effect on soil properties to that of use of FYM / vermicompost in higher quantities (without enrichment). It is very well known that when nutrients are chelated with organics, their use efficiency increases.

The information on Fe and Zn enriched organics (FYM/Vermicompost) in different crops are rare and scare, especially in wheat crop practiced on Fe and Zn deficient soil of Banaskantha of North Gujarat. Present study was aimed at assessing the effect of Fe and Zn enriched organics on nutrient content and uptake by wheat in loamy sand.

Material and Methods
A field experiment entitled "Effect of iron and zinc enriched organics on nutrient content and uptake by wheat (*Triticum aestivum* L.) in loamy sand" was conducted during *rabi* season of 2017-18 at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The soil of experimental field was loamy sand in texture and slightly alkaline in reaction. It was low in organic carbon, available N and DTPA-extractable Fe and Zn; medium in available P_2O_5, K_2O

and S whereas high in DTPA-extractable Mn and Cu content. Ten treatments *viz*., RDF (T_1), RDF + 5 t FYM ha^{-1} (T_2), RDF + 2 t VC ha^{-1} (T_3), RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1}(T_4), RDF + 0.5 t FYM ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1} (T_5), RDF + 0.2 t VC ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1} (T_6), RDF + 0.5 t FYM ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn(T_7), RDF + 0.2 t VC ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn(T_8), RDF + 0.5 t FYM ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn (T_9), RDF + 0.2 t VC ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn (T_{10}) were laid out under randomized block design with four replications. Wheat variety GW 451 was used as a test crop.

The enrichment process was started 45 days before their use in *rabi* experiment on wheat. The required quantity of FYM and vermicompost were filled in pre-dug pits of 1.5' × 1.5' × 1.5' size. The FYM (0.5 t ha^{-1}) and vermicompost (0.2 t ha^{-1}) was thoroughly mixed with the solution of $FeSO_4.7H_2O$ and $ZnSO_4.7H_2O$ having required concentration as per the enrichment treatments *viz*., 5.00 kg Fe + 2.50 kg Zn and 2.50 kg Fe + 1.25 kg Zn. The moisture percentage of FYM and vermicompost after mixing with $ZnSO_4.7H_2O$ and $FeSO_4.7H_2O$ were kept at about 75 to 80. The starter inoculums of microorganisms in the form of cow dung slurry @ 1 per cent was applied to boost up the microbiological activities for enrichment of natural process of composting to fix the externally added inorganic Fe and Zn into organically bound and naturally chelated form of Fe and Zn; The pit was covered with polythene sheet and allowed for decomposition. The mixture was turned over periodically (weekly) and moisture level was maintained. The data for total Fe and Zn content of FYM and vermicompost before and after enrichment are given in Table 1. The Fe and Zn enriched organics were used in a field experiment.

Table 1: Total contents of major and micronutrients in FYM and vermicompost (before and after enrichment)

Organics	Major nutrients (%)			Micro nutrients (mg kg^{-1})	
	N	P_2O_5	K_2O	Fe	Zn
Before enrichment					
FYM	0.61	0.32	0.57	3710	80
Vermicompost	1.41	1.07	0.61	4101	114
After enrichment					
0.5 t FYM ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn	0.64	0.37	0.58	6054	160
0.5 t FYM ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn	0.63	0.36	0.59	5340	125
0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn	1.52	1.22	0.80	7040	210
0.2 t vermicompost ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn	1.48	1.18	0.78	6110	185

The entire quantity of phosphorus (60 kg ha^{-1}) and half quantity nitrogen (60 kg ha^{-1}) were applied uniformly in opened furrow in the form of diammonium phosphate and urea, respectively. As per treatment the required quantity of Fe and Zn in the form of $FeSO_4.7H_2O$ (19% Fe) and $ZnSO_4.7H_2O$ (21% Zn) were applied in furrow, respectively. After that, application of Fe and Zn enriched FYM or vermicompost were applied in furrow as per the treatments. After fertilizer application, the furrows were covered with the soil in such a way that the furrow remained partly open for seed sowing. The remaining half dose of nitrogen (60 kg ha^{-1}) was top dressed in the form of urea at 23 days after sowing.

Wheat showing was completed on 14th November, 2017, by keeping the inter raw spacing of 22.5 cm with the seed rate of 120 kg ha^{-1}. The treatment wise representative samples of grain and straw were drawn at the time of harvest. These samples were kept in brown paper bags for air draying. Thereafter, the samples were kept in oven at 60º to 65º C for draying till the constant weight was obtained. The dried samples were powdered in a grinder having stainless steel blades to avoid contamination of micronutrients. Chemical analysis of grain and straw samples were done separately for N, P, Fe and Zn as per methods given in Table 2. The plant samples (grain and straw) were wet digested using di-acid mixture of HNO_3 and $HClO_4$ in 3:1 ratio (Johnson and Ulrich, 1959) [1]. The acid extract prepared after digestion was used for estimation of P, Fe and Zn. The concentration of the nutrients determined in plant samples (grain and straw) was expressed in per cent for major nutrients (N and P) and in mg kg^{-1} for micronutrients (Fe and Zn) on dry weight basis.

Table 2: Methods followed for plant analysis

Sr. No.	Determination	Method	Reference
1	Nitrogen	Micro Kjeldahl's digestion	Waranke and Barber (1974)
2	Phosphorus	Vanadomolybdo phosphoric acid yellow colour	Jackson (1973)
3	Potassium	Flame photometric	
4	Fe and Zn	Atomic absorption spectrophotometer (Model: ELICO SL 194)	

Result and Discussion

Nutrients content in grain and straw

The data presented in Table 3 revealed that concentration of N in grain and straw was increased significantly due to combined application of 5 t FYM ha^{-1} and 2 t VC ha^{-1} along with RDF (T_4) over rest of the treatments except treatments receiving either through 5 t FYM ha^{-1}) and or 2 t VC ha^{-1} along with RDF. However, P content in grain and straw remain unchanged due to different treatments. Whereas, an application of vermicompost @ 0.2 t ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn in conjunction with RDF (T_8) recorded significantly higher Fe and Zn content in grain and straw as compared to other treatments but remained at par with T_7 and T_{10} treatments.

The considerable increased in N content in both grain and straw due application of FYM (5 t ha^{-1}) + vermicompost (2 t ha^{-1}) along with RDF (T_4) could be attributed to fact that FYM / vermicompost had favourable effect on soil properties and makes more N available during crop growing period. The observed significant increase in Fe and Zn concentration in grain and straw due to application of Fe and Zn enriched FYM / vermicompost might be due to fact that soil of experiment plot was deficient in available iron and zinc and its application after enrichment of FYM and VC had

beneficial effect on mobilizing native Fe and Zn nutrients to increase their availability in soil and also addition of Fe and Zn to the soil in naturally chelated form to provide better nutrition over longer time that caused higher utilization of Fe and Zn by grain and straw. Similar findings were also reported by Yadav *et al.* (2011) [7] in wheat, Rathod *et al.* (2012) [5] in wheat and Parmar (2016) [2] in fenugreek.

Nutrients uptake by grain and straw

The significantly higher removal of N by grain and straw were obtained under the treatment of RDF along with 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn (T_8) but was at par with treatments of T_{10}, T_4, T_3, T_9 and T_7. However, an application of RDF along with 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn (T_8) registered significantly the higher P uptake by grain and straw over rest of the treatments except T_{10} and T_7 treatments by both grain and straw. Same treatment also recorded significantly the higher Fe uptake by grain and straw over rest of the treatments except T_{10} and T_7 treatments. Though the significantly higher removal of Zn by grain and straw were recorded under treatment of RDF + 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn (T_8), it was at par with T_{10} and T_7 by both grain and straw.

The higher uptake of P by grain and straw might be due attributed to the favorable influence of organic acid in mobilization of native soil to P that make readily available to roots during crop growing period. The Fe and Zn enriched FYM / vermicompost (T_8, T_{10}, and T_7) caused higher utilization of Fe and Zn mainly due to its beneficial effects in mobilizing the native nutrients to increase their availability besides addition of Fe and Zn to soil in naturally chelated form. This might have provided better nutrition over longer time to cause better crop growth and higher yields. The higher removal of Fe and Zn by grain and straw also be attributed to the priming effect of externally added Fe and Zn to improve crop growth and yield hence higher content of Fe and Zn in grain and straw and also higher grain and straw yields under Fe and Zn enriched FYM / vermicompost along with RDF application might have contributed towards higher uptake of Fe and Zn by grain and straw. These findings are in agreement with the results of Yadav *et al.* (2011) [7], Patel *et al.* (2016) [3] in grain amaranth in wheat and Parmar (2016) [2] in fenugreek.

Table 3: Effect of Fe and Zn enriched organics on N, P, Fe and Zn content by wheat

Treatments	N content (%)		P content (%)		Fe content (mg kg^{-1})		Zn content (mg kg^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1: RDF (120:60:00 kg N: P_2O_5 : K_2O ha^{-1})	1.80	0.502	0.247	0.232	34.99	128.16	43.09	20.70
T_2: RDF + 5 t FYM ha^{-1}	2.15	0.589	0.286	0.238	39.16	141.74	44.54	22.10
T_3: RDF + 2 t VC ha^{-1}	2.13	0.583	0.284	0.237	40.30	152.56	46.37	23.37
T_4: RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1}	2.16	0.602	0.289	0.239	42.63	163.42	48.30	25.30
T_5: RDF + 0.5 t FYM ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	1.92	0.530	0.279	0.233	47.08	178.37	50.61	26.61
T_6: RDF + 0.2 t VC ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	1.92	0.538	0.279	0.233	48.54	183.28	52.92	27.92
T_7: RDF + 0.5 t FYM ha^{-1} En. with 5.00 kg Fe and 2.50 kg Zn	1.93	0.548	0.280	0.235	58.20	233.58	56.90	32.90
T_8: RDF + 0.2 t VC ha^{-1} En. with 5.00 kg Fe and 2.50 kg Zn	2.03	0.566	0.283	0.236	59.95	236.63	57.31	33.31
T_9: RDF + 0.5 t FYM ha^{-1} En. with 2.50 kg Fe and 1.25 kg Zn	2.01	0.558	0.282	0.236	54.92	221.69	54.63	30.63
T_{10}: RDF + 0.2 t VC ha^{-1} En. with 2.50 kg Fe and 1.25 kg Zn	1.96	0.553	0.281	0.235	56.90	226.01	55.98	32.00
S.Em±	0.03	0.009	2.909	0.003	1.06	3.76	0.47	0.47
CD *(P = 0.05)*	0.10	0.027	NS	NS	3.08	10.72	1.36	1.36
CV%	3.30	3.31	5.61	2.24	4.39	3.85	1.84	3.41

Table 4: Effect of Fe and Zn enriched organics on N, P, Fe and Zn uptake by wheat

Treatments	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		Fe uptake (g ha^{-1})		Zn uptake (g ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1: RDF (120:60:00 kg N: P_2O_5 : K_2O ha^{-1})	75.19	25.61	10.35	11.82	145.7	653.6	179.7	105.6
T_2: RDF + 5 t FYM ha^{-1}	94.33	31.07	12.56	12.54	171.9	746.6	195.6	116.5
T_3: RDF + 2 t VC ha^{-1}	96.73	31.77	12.90	12.88	182.7	830.0	210.3	127.2
T_4: RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1}	99.85	33.28	13.32	13.25	196.9	905.6	222.9	140.0
T_5: RDF + 0.5 t FYM ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	88.80	29.47	12.95	12.96	218.5	993.3	234.7	148.1
T_6: RDF + 0.2 t VC ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	89.38	30.00	12.99	13.01	225.8	1023.0	246.0	155.7
T_7: RDF + 0.5 t FYM ha^{-1} En. with 5.00 kg Fe and 2.50 kg Zn	95.99	32.65	13.93	14.02	289.1	1392.4	282.9	196.4
T_8: RDF + 0.2 t VC ha^{-1} En. with 5.00 kg Fe and 2.50 kg Zn	109.96	36.62	15.29	15.30	323.6	1532.5	309.4	215.7
T_9: RDF + 0.5 t FYM ha^{-1} En. with 2.50 kg Fe and 1.25 kg Zn	96.31	32.02	13.47	13.54	262.7	1272.6	261.4	175.8
T_{10}: RDF + 0.2 t VC ha^{-1} En. with 2.50 kg Fe and 1.25 kg Zn	101.44	34.31	14.55	14.63	294.2	1402.3	289.5	198.5
S.Em±	4.87	1.42	0.62	0.58	11.9	53.9	11.3	7.8
CD *(P = 0.05)*	14.13	4.11	1.78	1.69	34.6	156.4	32.7	22.5
CV%	10.27	8.94	10.83	8.69	9.96	10.02	9.3	9.8

Conclusion

Based on the results of present study, the higher content and uptake of nutrients by wheat crop can be obtained by an application of 5.00 kg Fe and 2.50 kg Zn after enrichment of either vermicompost @ 200 kg ha^{-1} or FYM @ 500 kg ha^{-1} or application of 2.50 kg Fe and 1.25 kg Zn after enrichment of vermicompost @ 200 kg ha^{-1} in conjunction with RDF (120 : 60 : 00 kg N : P_2O_5 : K_2O ha^{-1}) compared to only RDF in loamy sand soil deficient in available N, Fe and Zn whereas medium in available P status.

Reference

1. Johnson CM, Ulrich A. Analytical methods for use in plant analysis, University of California, U.S 1959.
2. Parmar SJ. Effect of iron and zinc enriched FYM on yield and quality of fenugreek. M.Sc. (Agri.) Thesis,

Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar 2016.
3. Patel SM, Amin AU, Patel BT. Yield and quality of cumin as influenced by FYM enriched micronutrients. International Journal of Seed Spices 2016;6(1):17-24.
4. Prasad B. Conjoint use of fertilizers with organics, crop residues and green manuring for their efficient use in sustainable crop production. Fertilizer News 1999;44(5):67-73.
5. Rathod DD, Meena MC, Patel KP. Evaluation of different zinc enriched organics as source of zinc under wheat-maize cropping sequences on zinc-deficient Typic Haplustepts. Journal of the Indian Society of Soil Science, 2012;60(1):50-55.
6. Singh MV. Micro and secondary nutrients and pollutant elements research in India. Progress Report, IISS, Bhopal 2006, 1-110.
7. Yadav RS, Patel AM, Dodia IN, Aglodiya AV, Patel GA, Augustine N. Agronomic bio-fortification of wheat (*Triticum aestivum* L.) through iron and zinc enriched organics. Journal of Wheat Research 2011;3:46-51.