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Effect of Iron and Zinc Enriched Organics on Growth, Yield Attributes and Yield of Wheat in Loamy Sand

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A B S T R A C T

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 growth, yield attributes and yield of wheat(*Triticum aestivum* L.) in loamy sand (Typic *Ustipsamments*) during *rabi* season of 2017-18.The results revealed that an application of vermicompost @ 0.2 t ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn in conjunction with recommended dose of fertilizer (RDF) significantly improved growth and yield attributes *viz.* plant height, number of effective tillers per meter row length, length of earhead, number of grains per earhead, 1000 grain weight and grain and straw yield of wheat as compared to control (RDF).

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). On the basis of 7587 soil samples collected from different districts of Gujarat, it was found that 25.9 and 25.6 per cent samples were deficient in Fe and Zn, respectively (Patel *et al.,* 2018). Desai *et al.,* (2018) collected 556 soil samples from different *talukas* of Banaskantha district and

found that 34.8 and 37.6 per cent samples were deficient in Fe and Zn, respectively. Iron and zinc deficiencies are common micronutrient deficiency in light textured soils of North Gujarat limiting both crop production and nutrition quality.

The deficiencies of micronutrients have become major constraint for maintaining productivity of soil. 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 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 extent (Meena *et al.*, 2006).

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 growth, yield attributes and yield of wheat crop.

Materials and Methods

A field experiment was conducted on a Fe and Zn deficient loamy sand (Typic *Ustipsamments*) soil during *rabi* season of 2017-18 atAgronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The soil of experimental field 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 Feand 2.50 kg Zn ha^{-1} (T_5), RDF + 0.2 t VC ha^{-1} + 5.00 kg Feand 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.

The enrichment process was started 45 days before their use in *rabi* experiment on wheat. The quantity of FYM (0.5 t ha^{-1}) and vermicompost (0.2 t ha^{-1})were thoroughly mixed with 1% cow dung slurry and andthe 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 $FeSO_4.7H_2O$ and $ZnSO_4.7H_2O$ were kept at about 75 to 80.

The mixtures were filled in pre-dug pit and 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 N, P_2O_5, K_2O, 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. Farm yard manure (0.5 and 5.0 t ha^{-1}) and vermicompost (0.2 and 2.0 t ha^{-1}) were applied as per treatment in experiment.

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 after first irrigation.

Wheat variety GW 451 was sown in rows at 22.5 cm apart with 120 kg seed ha^{-1}. Number of plants per meter row length and numbers of effective tillers per meter length were counted from randomly five spot of each net plot area just before harvest of crop. The average value was worked out. The observation on growth and yield attributes such as plant height and length of earhead in centimeter was recorded from five randomly selected plant from each net plot at physiological maturity stage and average value for such treatment was workout.

The earhead of the five selected plants were threshed separately and the numbers of grains were counted from each earhead and the mean values were recorded. The produce from each net plot area was threshed separately. After winnowing from each net plot were weighed separately and recorded in kg per net plot. The grain weights of earlier threshed five plants for each treatment were also added to respective net plot for each treatment. Thereafter it was converted into kilogram per hectare. A composite sample of grains was collected from the produce of each net plot and one thousand grains were counted using seed counter and then weighed 1000-grain by using electronic balance. Straw yield was obtained by subtracting the grain yield of each net plot from their respective biological yield and recorded separately for each treatment along with straw yield of tagged five plants and converted into kilogram per hectare.

Results and Discussion

Growth and yield attributes

The data presented in Table 2revealed that different treatments did not exert any significant influence on plant population per meter row length at harvest. The results clearly indicated that plant populations per meter row length in experimental plot were uniform. Hence, various growth and yield attributes of crop was not influenced due to variation in the plant population.

Among different treatment tested, the treatment receiving recommended dose of fertilizer along with 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn in conjunction with RDF recorded significantly higher plant height, number of effective tillers per meter row length at harvest and length of earhead than the other treatments but it was found at par with treatment receiving RDF + 0.2 t vermicompost ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn and RDF + 0.5 t FYM ha^{-1} enriched with either 5.00 kg Fe + 2.50 kg Zn or 2.50 kg Fe + 1.25 kg Zn. The maximum grains per earhead and 1000 grain weight were recorded under treatment of RDF + 0.2 t vermicompost enriched with 5.00 kg Fe and 2.50 kg Zn. The minimum plant height was recorded under treatment receiving RDF (T_1).

The observed significant increase in growth and yield attributes such as plant height, number of effective tillers per meter row length at harvest, length of earhead, number of grains per earhead and 1000 grain weight

under treatments of 0.2 t vermicompost or 0.5 t FYM enriched with either 5.00 kg Fe and 2.50 kg Zn or 2.50 kg Fe and 1.25 kg Zn could be due to fact that enrichment technique caused mobilization the native nutrients to increase their availability besides addition of Fe and Zn in naturally chelated form which are expected to become slowly available to growing crop over longer time.

This might helped to balance nutrition of Fe and Zn besides supplementing other essential plant nutrients and made them available to crop for longer time that causes better crop growth and yielding attributes characters. These findings are in agreement with those of Yadav *et al.*, (2011) in wheat, Rathod *et al.*, (2012) in maize, Bandiwaddar *et al.*, (2016) in wheat and Parmar (2016) in fenugreek.

Grain and straw yield

An application of RDF along with 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn produced significantly the highest grain and straw yields of wheat over rest of the treatments except treatment receiving RDF + 0.2 t vermicompost ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn and RDF + 0.5 t FYM ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn. The minimum grain as well as straw yield was obtained under treatment of RDF (control).The magnitude of increase in grain and straw yields due to application of RDF along with 0.2 t vermicompost ha^{-1} enriched with 5.00 kg Fe and 2.50 kg Zn (T_8) was to the tune of 29.4 and 26.8 per cent, respectively over RDF (control).

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

Organics	Major Nutrients (%)			Micro Nutrients (µg g^{-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

Table.2 Effect of Fe and Zn enriched organics on growth, yield attributes and yields of wheat

Treatments	Plant population (per meter row length)	Plant height (cm)	Effective tillers per meter	Length of earhead (cm)	Grains per earhead	1000-grain weight (g)	Yield (kg ha^{-1})	
							Grain	Straw
T_1: RDF (120:60:00 kg N: P_2O_5 : K_2O ha^{-1})	48.4	82.1	80.1	7.65	29.19	37.7	4173	5108
T_2: RDF + 5 t FYM ha^{-1}	48.7	82.3	90.1	7.67	30.22	39.3	4392	5270
T_3: RDF + 2 t VC ha^{-1}	49.5	84.0	91.2	7.92	30.51	39.5	4537	5444
T_4: RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1}	49.6	87.5	92.1	8.28	31.33	39.8	4617	5541
T_5: RDF + 0.5 t FYM ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	49.8	87.8	94.1	8.39	33.16	40.1	4638	5566
T_6: RDF + 0.2 t VC ha^{-1} + 5.00 kg Fe and 2.50 kg Zn ha^{-1}	49.9	88.4	94.8	8.45	34.22	40.1	4649	5579
T_7: RDF + 0.5 t FYM ha^{-1}enriched with 5.00 kg Fe and 2.50 kg Zn	50.5	92.8	100.4	8.85	37.54	41.2	4969	5963
T_8: RDF + 0.2 t VC ha^{-1}enriched with 5.00 kg Fe and 2.50 kg Zn	51.3	97.0	105.4	9.50	40.77	43.1	5400	6480
T_9: RDF + 0.5 t FYM ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn	50.0	91.8	99.3	8.53	35.21	40.6	4785	5742
T_{10}: RDF + 0.2 t VC ha^{-1} enriched with 2.50 kg Fe and 1.25 kg Zn	50.6	94.4	101.9	9.07	38.41	42.1	5176	6212
S.Em±	1.7	2.9	3.5	0.34	1.66	0.8	209	251
C.D.*(P = 0.05)*	NS	8.4	10.3	0.98	4.81	2.3	607	728
CV%	6.51	6.55	7.47	8.03	9.74	4.01	8.84	8.82

The observed significant increase in grain and straw yield of wheat due to application of FYM/vermicompost enriched with either 5.00 kg Fe and 2.50 kg Zn or 2.50 kg Fe and 1.25 kg Zn might be due to fact that the soils of experimental plot was deficient in available Fe and Zn (Fe 4.48 mg kg^{-1} and Zn 0.38 mg kg^{-1}) and its application after enrichment of FYM/vermicompost improve its availability in soil which might have enhance the yield attributes such as plant height, length of earhead, number of grains per earhead and 1000 grain weight and finally contributed to higher grain and straw yield of wheat. These results are in the line of those reported by Yadav *et al.,* (2011) and Rathod *et al.,* (2012) in wheat, Parmar (2016) in fenugreek and Patel *et al.,* (2016) in cumin.

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