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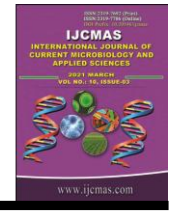

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Effect of Iron Application in Grain Amaranthus (*Amaranthus hypochondriacus* L.) Grown in Typic Ustocerpts under Middle Gujarat Condition

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Micronutrients are essential for the plant system, animals and humans growth, are receiving increased attention as their deficiency in soil is threatening the agricultural sustainability, nutritional quality as well as animal and human health. In order to assess the effect of Fe application in Grain Amaranthus (*Amaranthus hypochondriacus* L.) crop under middle Gujarat condition, a field experiment was conducted during *Rabi* season, 2019-2020 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat). The experiment consists of twelve treatments laid out in randomized block design replicated four times. The results revealed that the application of recommended dose of fertilizer (30-15-00 NPK kg ha^{-1}) coupled with enriched 200 kg FYM ha^{-1} with 15 kg $FeSO_4$ recorded significantly highest plant growth and yield attributes *viz.*, plant height, panicle length, grain (15%) and stover yield (20%)over recommended dose of fertilizer (control).While, significantly highest content of nitrogen (2.43%) and iron (102.3 mg kg^{-1}) content in amaranthus grain was observed under the application of recommended dose of fertilizer along with $FeSO_4$application at 11.25 kg ha^{-1} through enriched 200 kg FYM.

Introduction

The demand for food of increasing ever population of India is increasing day to day but the agricultural production in the country is not much increased. The practice of intensive cropping with hybrid varieties for boosting food production in India has caused nutrient depletion in soil. Consequently macro- and micro-nutrient deficiencies are reported in soils of India. However, the agricultural production was increased, but availability and accessibility of food (i.e. food security) to the population is still the major problem. Also, not only the food security but nutritional security is the most important. Nutritional security is an essential element of food security.

Micronutrient deficient soils result in production of food/feed/fodder low in micronutrient content/density and that in the long-run have been inflicting their deficiency in humans and animals. Hence, the rampant micronutrient deficiency in soils has resulted in increased incidence of micronutrients deficiencies in animals and humans in recent years and taking a toll on the food and economic security of the country in terms of the yield and economic losses due to unmatched yield goals (Shukla *et al.*, 2014). Thus, micronutrients, essential for plant, animals and humans growth, has been receiving increased attention as their deficiency is threatening the agricultural sustainability, nutritional quality as well as animal and human health.

Two billion people (more than one-in-three) around the world suffer from micronutrient deficiency (FAO, 2013). Every day, more than 6,000 children below the age of five die in India and more than half of these deaths are caused due to malnutrition mainly via lack of iron, zinc, vitamin A, iodine and folic acid (Kotecha, 2008).

Iron deficiency is considered to be the common worldwide nutritional deficiency that affects approximately 20% of the world population. Women and children are especially at risk (http://www.who.int/nut/research1.htm).Various physiological diseases, such as anemia and some neurodegenerative diseases are triggered by Fe deficiency (Sheftela *et al.*, 2012; Schuler and Bauer, 2012). Especially those countries are affected by Fe deficiency diseases, where people have low meat intake and the diets are mostly based on staple crops. Human health problems caused by Fe deficiency can be prevented by specific attention to food composition and by choosing a balanced diet with sufficient Fe concentration. Iron deficiency is a common nutritional disorder in many crop plants, causing chlorosis, poor yield and reduced nutritional quality (Zhang *et al.,* 2008).

A lot of research work has been done to enhance micronutrient content in cereal grains and there is a need to explore the possibility of such improvements in other locally available food crops. One such crop that could be considered suitable for this purpose is of the genus *Amaranthus.* Grain Amaranthus (*Amaranthus hypochondriacus* L.) is a neglected pseudocereal crop. Amaranthus belongs to the family *Amaranthaceae.* It is originated from Central and South America. In India, amaranthus is commonly grown in Himachal Pradesh and in the hills of Uttar Pradesh for both grains and greens. It is a short duration, low input underexploited multipurpose crop used as vegetable, grain crop, medicinal, forage and as an ornamental plant. It can be grown on a wide range of soils, however, sandy loam soil, slightly acidic in reaction is preferred.

The amaranth grains contain relatively higher iron content than in cereal grains. It is an excellent source of iron and β-Carotene and thus it can help in removing iron and vitamin

A deficiency (Narwade *et al.,* 2018). Amaranth has complete protein and is also a good source of minerals such as iron, magnesium, phosphorus, copper and manganese. It’s unique composition makes it an attractive food complement and supplement. Looking to the above scenario, the research work on effect of Iron in grain amaranthus (*Amaranthus hypochondriacus* L.) under middle Gujarat condition.

Materials and Methods

A field experiment was conducted during *Rabi* season of the year 2019-2020 at College Agronomy farm, BACA, Anand Agricultural University, Anand, Gujarat. This experiment consisting of twelve treatment combinations in randomized block design, which was replicated four times and amaranthus variety GA - 2 was sown. Details are furnished below in Table 1.

RDF was applied in common to all the plots where in nitrogen dose was applied at 50 % basal and 50 % at 30 DAS and 50 DAS respectively, While, total quantity of recommended dose of P_2O_5 was applied through diammonium phosphate (DAP) as basal. Application of Bio NPK consortium (*Azotobacter* + PSB + KSB) was made through seed treatment at 10 ml kg^{-1} seed as well as soil drenching at 1 liter ha^{-1} at 30 DAS. $FeSO_4$ was applied as per treatment and for iron enriched FYM, the quantity of 200 kg FYM was taken and thoroughly mixed with the solution of $FeSO_4.7H_2O$ as per treatment. The thoroughly mixed materials was filled in the pits treatment wise and incubated for a period of 50 days. The 50 per cent available soil moisture was maintained in the pits till 50 days. After 50 days, the enriched manure was utilized as soil application as per treatment at the time of sowing of amaranthus crop. The soil of the experimental field was loamy sand in texture, alkaline in reaction.

Plant analysis

After harvest of the crop, amaranthus grain and stover and leaves at 45 DAS samples were taken for analysis. The samples were dried in paper bags at 70^0C till constant weight in a hot air oven and preserved for further analysis. These samples were ground in a stainless steel grinder to avoid contamination of nutrients. The processed samples were preserved in airtight polyethylene bags for further analysis.

The total N was determined by (Kjeldahl's digestion method) digestion of plant samples with concentrated sulphuric acid. The digested sample is estimated by using micro kjeldahl apparatus. For P, K and micro nutrients, samples digested in di-acid mixture (HNO_3 : $HCLO_4$ – 3:1) and fine volume was prepared with double distilled water. The extract was filtered through Whatman filter paper No.42. The digested extract of plant samples was used analysis of phosphorus (Vanadomolybdate yellow colour), potassium (Flame photometric method) and micronutrients (Di-acid digestion). Standard error of mean (S.Em) and Co-efficient of variation (CV %) were worked out for each observation as per the method suggested by Steel and Torrie (1982) (Table 2).

Results and Discussion

Growth and yield

In this study, the growth and yield of amaranthus was enhanced with the recommended dose of fertilizers along with soil application of $FeSO_4$ through enriched 200 kg FYM compared to control (Table 3). Highest plant height at 25 DAS(42.33cm) and 50 DAS (42.33cm) and panicle length (58.45cm)was recorded with RDF along with soil application of $FeSO_4$ @ 15 kg ha^{-1}through enriched 200 kg FYM. The increase in plant height was due to supplementation of deficient nutrient in soil may have triggered better vegetative growth of plants. Also, biofertilizer seed treatment influences root rhizosphere by inducing plant growth promoting substance which might have improved the root growth, there by shoot growth of the amaranthus. The results are in close vicinity with the findings of Veeranagappa (2009).

Table.1 Details of treatment

Treatment	Abbreviation	Treatment details
T_1	Control	RDF (Control)
T_2	BF	RDF + Bio NPK Consortium
T_3	FYM200	RDF + 200 kg FYM ha^{-1}
T_4	$Fe_{7.5}SA$	RDF + 7.5 kg $FeSO_4$ ha^{-1}
T_5	$Fe_{7.5}SA$+BF	RDF + 7.5 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium
T_6	Ench.$Fe_{7.5}SA$	RDF + Enriched 200 kg FYM ha^{-1} with 7.5 kg $FeSO_4$
T_7	$Fe_{11.25}SA$	RDF + 11.25 kg $FeSO_4$ ha^{-1}
T_8	$Fe_{11.25}SA$+BF	RDF + 11.25 kg FeSO4 ha^{-1} + Bio NPK Consortium
T_9	Ench.$Fe_{11.25}SA$	RDF + Enriched 200 kg FYM ha^{-1} with 11.25 kg $FeSO_4$
T_{10}	$Fe_{15}SA$	RDF + 15 kg $FeSO_4$ ha^{-1}
T_{11}	$Fe_{15}SA$+BF	RDF + 15 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium
T_{12}	Ench.$Fe_{15}SA$	RDF + 15 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium

Table.2 Initial soil status of experimental soil

Sr. No.	Soil properties		Values at soil depth (0-15 cm)
1.	PHYSICAL PROPERTIES		
	Mechanical fraction (International pipette method)		
	(a)	Coarse sand (%)	2.40
	(b)	Fine sand (%)	77.35
	(c)	Silt (%)	10.5
	(d)	Clay (%)	5.2
	(e)	Bulk density (Mg m^{-3})	1.51
	(f)	Maximum water holding capacity (%)	38.05
	(g)	Textural class	Loamy sand
2.	CHEMICAL PROPERTIES		
	(a)	Soil pH (1:2.5, Soil : Water)	8.12
	(b)	Electrical Conductivity (dS m^{-1}) (1:2.5, Soil : Water)	0.22
	(c)	Organic Carbon (%)	0.39
	(d)	Available N (kg ha^{-1})	181
	(e)	Available P_2O_5 (kg ha^{-1})	39.2
	(f)	Available K_2O (kg ha^{-1})	269.3
	(g)	DTPA Extractable Micronutrients (mg kg^{-1})	
		Fe	4.40
		Mn	6.20
		Zn	0.84
		Cu	1.24

Table.3 Effect of iron on plant height, panicle length and yield of grain and stover of amaranthus

Trt.	Treatment Details	Plant height (cm)			Panicle len (cm)	Yield (kg ha^{-1})	
		25 DAS	50 DAS	At harvest		Grain Yield	Stover Yield
T_1	RDF (Control)	32.08	73.58	138	46.03	1154	3876
T_2	RDF + Bio NPK Consortium	36.80	79.38	139	51.70	1216	4199
T_3	RDF + 200 kg FYM ha^{-1}	34.63	76.20	144	49.53	1201	4253
T_4	RDF + 7.5 kg $FeSO_4$ ha^{-1}	38.82	81.08	145	55.58	1256	4320
T_5	RDF + 7.5 kg $FeSO_4$ha^{-1} + Bio NPK Consortium	39.13	86.15	148	56.53	1283	4390
T_6	RDF + Enriched 200 kg FYM ha^{-1} with 7.5 kg $FeSO_4$	39.35	80.40	150	56.93	1293	4472
T_7	RDF + 11.25 kg $FeSO_4$ha^{-1}	41.10	85.40	146	56.20	1268	4432
T_8	RDF + 11.25 kg $FeSO_4$ ha^{-1} +Bio NPK Consortium	39.85	84.85	149	56.68	1293	4354
T_9	RDF + Enriched 200 kg FYM ha^{-1}with 11.25 kg $FeSO_4$	40.00	85.00	151	57.30	1326	4527
T_{10}	RDF + 15 kg $FeSO_4$ha^{-1}	39.05	83.80	147	56.03	1274	4485
T_{11}	RDF + 15 kg $FeSO_4$ha^{-1} + Bio NPK Consortium	40.93	82.55	148	56.13	1288	4408
T_{12}	RDF + Enriched 200 kg FYM ha^{-1}with 15 kg $FeSO_4$	42.33	87.50	148	58.45	1326	4651
S.Em.±		1.65	2.79	5.13	2.28	2.28	135
C.D. (P = 0.05)		4.73	8.03	NS	6.56	6.56	389
C.V. %		8.51	6.80	7.02	8.33	8.33	6.20

Table.4 Effect of iron on N, P and Fe content in amaranthus grain, stover and leaves at 45 DAS

Trt.	Treatment Details	N content (%)		P content (%)		Fe content (mg kg^{-1})		
		Grain	Stover	Grain	Stover	Grain	Stover	Leaves at 45 DAS
T_1	RDF (Control)	2.07	0.76	0.39	0.24	82.4	161	198
T_2	RDF + Bio NPK Consortium	2.24	0.81	0.41	0.25	85.7	169	208
T_3	RDF + 200 kg FYM ha^{-1}	2.17	0.82	0.40	0.25	87.5	164	210
T_4	RDF + 7.5 kg $FeSO_4$ha^{-1}	2.23	0.89	0.44	0.27	92.3	176	217
T_5	RDF + 7.5 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium	2.23	0.81	0.44	0.28	94.8	177	219
T_6	RDF + Enriched 200 kg FYM ha^{-1} with 7.5 kg $FeSO_4$	2.39	0.96	0.45	0.28	100.1	183	224
T_7	RDF + 11.25 kg $FeSO_4$ ha^{-1}	2.24	0.87	0.44	0.29	96.1	179	221
T_8	RDF + 11.25 kg $FeSO_4$ha^{-1} + Bio NPK Consortium	2.26	0.93	0.43	0.27	98.0	176	216
T_9	RDF + Enriched 200 kg FYM ha^{-1} with 11.25 kg $FeSO_4$	2.43	0.90	0.45	0.30	102.3	183	225

T_{10}	RDF + 15 kg $FeSO_4$ ha^{-1}	2.32	0.89	0.42	0.30	99.3	183	228
T_{11}	RDF + 15 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium	2.40	0.97	0.43	0.29	98.5	181	223
T_{12}	RDF + Enriched 200 kg FYM ha^{-1} with 15 kg $FeSO_4$	2.34	0.94	0.42	0.31	100.9	184	230
S.Em.±		0.07	0.043	0.016	0.02	3.34	5.37	6.30
C.D. (P = 0.05)		0.208	0.125	NS	NS	9.60	15.45	18.13
C.V. %		6.36	9.86	7.32	12.81	7.04	6.09	5.77

Table.5 Effect of iron on N, P and Fe uptake by amaranthus grain and stover

Trt.	Treatment Details	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		Fe uptake (g ha^{-1})	
		Grain	Stover	Grain	Stover	Grain	Stover
T_1	RDF (Control)	23.81	29.61	4.53	9.12	96	627
T_2	RDF + Bio NPK Consortium	27.22	33.95	5.00	10.38	104	709
T_3	RDF + 200 kg FYM ha^{-1}	26.02	34.88	4.80	10.62	105	696
T_4	RDF + 7.5 kg $FeSO_4$ ha^{-1}	27.88	38.34	5.47	11.47	116	759
T_5	RDF + 7.5 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium	28.64	35.51	5.69	12.37	122	777
T_6	RDF + Enriched 200 kg FYM ha^{-1} with 7.5 kg $FeSO_4$	30.94	42.91	5.81	12.30	129	820
T_7	RDF + 11.25 kg $FeSO_4$ ha^{-1}	28.36	38.73	5.61	12.85	122	793
T_8	RDF + 11.25 kg $FeSO_4$ ha^{-1}+ Bio NPK Consortium	29.21	40.68	5.53	11.68	127	766
T_9	RDF + Enriched 200 kg FYM ha^{-1} with 11.25 kg $FeSO_4$	32.24	40.79	6.01	13.46	136	830
T_{10}	RDF + 15 kg $FeSO_4$ ha^{-1}	29.52	39.80	5.40	13.55	127	817
T_{11}	RDF + 15 kg $FeSO_4$ ha^{-1} + Bio NPK Consortium	30.85	42.60	5.47	12.89	127	799
T_{12}	RDF + Enriched 200 kg FYM ha^{-1} with 15 kg $FeSO_4$	31.02	43.66	5.59	14.32	134	854
S.Em.+		1.47	2.15	0.262	0.714	5.60	33.37
C.D. (P = 0.05)		4.23	6.20	0.755	2.05	16.11	96.02
C.V. %		10.20	11.22	9.71	11.81	9.31	8.66

The highest grain (1326 kg ha^{-1}) and straw (4651kg ha^{-1}) yield was recorded with RDF along with soil application of $FeSO_4$ @ 15 kg ha^{-1} through enriched 200 kg FYM. Increase in yield was due to improved availability of iron which could be attributed to the formation of stable organometalic complexes with organic matter, especially during the enrichment process to last for a longer time and release the nutrients slowly in the soil system in such a way that the nutrients are protected from fixation and made available to the plant root system throughout the crop growth (Meena *et al.,* 2006). This could be due to the favorite effect of adding FYM as a good source of plant nutrients. Furthermore, FYM acts as a natural soil conditioner which improved soil properties and consequently soil productivity.

Nutrient content

The data obtained by the influence of different levels of iron enriched with FYM and without enriched with FYM on nitrogen, phosphorus, iron content in grain and stover and leaves at 45 DAS are presented in Table 4. From the perusal of the data, it was observed that N, P and Fe content in amaranthus grain, stover and leaves at 45 DAS show the significant change due to iron enriched with FYM and without enriched FYM. Significantly higher nitrogen (2.43%) and iron (102.3 mg kg^{-1}) content in grain was observed by the application of recommended dose of fertilizer along with soil application of $FeSO_4$ @ 11.25 kg ha^{-1} through enriched 200 kg FYM. Highest Fe content in stover (184 mg kg^{-1}) and leaves at 45 DAS (230mg kg^{-1}) was recorded under recommended dose of fertilizer along with soil application of $FeSO_4$ @ 15 kg ha^{-1} through enriched 200 kg FYM. While, Highest nitrogen content (0.97%) in stover was observed under the recorded under recommended dose of fertilizer, soil application of $FeSO_4$ @ 15 kg ha^{-1} along with Bio NPK Consortium (Malav*et al.*, 2019).

A perusal of the data presented in Table 5 indicates that the nitrogen (32.24 kg ha^{-1}), phosphorus (6.01 kg ha^{-1}) and iron uptake (136 g ha^{-1}) by amaranthus grain were recorded highest at application of recommended dose of fertilizer along with soil application of $FeSO_4$ @ 11.25 kg ha^{-1} through enriched 200 kg FYM. While highest nitrogen (43.66 kg ha^{-1}), phosphorus (14.32 kg ha^{-1}) and iron uptake (854 g ha^{-1}) by amaranthus stover were recorded with application of $FeSO_4$ @ 15 kg ha^{-1} through enriched 200 kg FYM.

In conclusion on the basis of experimental results soil application of $FeSO_4$ at 15 kg through enriched 200 kg FYM ha^{-1} along with RDF is recommended for maximum growth and yield of amaranthus crop.

While in case of nutrient content, soil application of 11.25 kg through enriched 200 kg FYM ha^{-1} along with RDF is recommended for amaranthus.

References

Ahmad N, Kalakoti P, Bano R and Aarif S.M. (2010).The prevalence of anaemia and associated factors in pregnant women in a rural Indian community. *Aust Med J*, 3(5): 276–280.

FAO, (2013).The State of Food and Agriculture, Food and Agriculture Organisation. Rome.

Kotecha, P.V. (2008). Micronutrient malnutrition in India: let us say “no” to it now. *Indian J. Community Med*, 33(1): 9-10

Malav. J., Salvi. N., Jat. J., Pavaya, R., Patel, B. & Patel, V. (2019).Effect of Iron and Zinc Enriched FYM on Growth, Yield and Quality of Wheat (*Triticum aestivum* L.) in salt affected soils of Gujarat. *International Journal of Current Microbiology and Applied Sciences*, 8: 2960-2969.

Meena, M. C., Patel, K. P. and Rathod, D. D. (2006). Effect of Zn and Fe enriched FYM on mustard yield and micronutrient availability in Loamy sand soil (*Typic haplustept*) of Anand. *Journal of the Indian Society of Soil Science*, 54: 495-499.

Narwade, S. and Pinto, S. (2018). Amaranth– A functional food. *Concepts Dairy and Veterinary Science*, *1:*72-77.

Schuler, M. and Bauer, P. (2012). Strategies for iron biofortification of crop plants. *Food Quality*.

Sheftel, A. D., Mason, A. B. and Ponka, P. (2012). The long history of iron in the Universe and in health and disease. *Biochimica et Biophysica Acta (BBA)-General Subjects*, *1820* (3) : 161-187.

Shukla, A. K., Tiwari, P. K. and Prakash, C. (2014).Micronutrients deficiencies vis-à-vis food and nutritional security of India. *Indian Journal of Fertilizers*,10 (12) : 94– 112.

Steel, G. D. and Torrie. J. H. (1982). Principles and procedures of statistics.

Veeranagappa, P. (2009). Effect of zinc enriched compost on soil properties, yield and uptake of nutrients by rice (*Oryza sativa* L.). MSc. thesis submitted to University of Agricultural Sciences-Bengaluru.

Zhang, J., Wu, L. H. and Wang, M. Y. (2008).Iron and zinc biofortification in polished rice and accumulation in rice plant (*Oryza sativa* L.) as affected by nitrogen fertilization. *Acta Agriculturae Scandinavica Section B–Soil and Plant Science*, 58(3): 267-272.

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