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Response of Varieties to Foliar Application of Zn and Fe for Yield and Quality Parameters of Okra

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ABSTRACT: Micronutrient disorder appears to be the most widespread and frequent problem in crop production worldwide, resulting in severe losses in yield and nutritional values. To overcome this problem study was conducted. The experiment was conducted in *kharif* during 2020 and 2021 in Factorial RBD with three replications and fourteen treatment combinations comprising two varieties *i.e.*, V_1: GAO 5 and V_2: GO 6 and seven level of foliar application of Zn and Fe *viz.,* M_1: $FeSO_4$ @ 0.50 %, M_2: $ZnSO_4$ @ 0.50 %, M_3: Fe EDDHA @ 0.1 %, M_4: Fe EDDHA @ 0.2 %, M_5: Zn EDTA @ 0.1 %, M_6: Zn EDTA @ 0.2 % and M_7: Control (Water spray). Which were sprayed in four frequencies at 30, 40, 50 and 60 DAS. Variety GAO 5 recorded the maximum pods per plant (20.50), pod yield (258.89 g/plant and 13.91 t/ha), fibre content of pod (2.56%), chlorophyll content of pod (0.496 mg/100 g), phenol content of pod (0.112%), and the lowest amount of leaf membrane damage (32.72%). Foliar application of Zn EDTA @ 0.2% resulted in maximum days to last picking (96.93), number of pods per plant (21.35), pod weight (14.43 g), pod yield (269,44 g/plant and 14.64 t/ha), fibre content of pod (2.62%), chlorophyll content of pod (0.504 mg/100 g), phenol content of pod (0.119 %) and least amount of leaf membrane injury (26.92 %). Zn EDTA applied topically at 0.2% with variety GAO 5 produced the maximum pods per plant (24.22), with the highest chlorophyll content (0.509 mg/100 g).

Keywords: Varieties, Zn EDTA, foliar spray, yield, okra.

INTRODUCTION

The vegetable crop known as okra [*Abelmoschus esculentus* (L.) Moench] is one of the most significant in the tropical and subtropical regions. Okra is a member of the family Malvaceae. In many regions of the world, it is known by a variety of regional names. For instance, it is referred to as lady's finger in England, gumbo in America, and bhindi in India. The green tender pod of okra contains oxalic acid, thiamine, riboflavin, nicotinic acid. It offers minerals like calcium, potassium, iron, and other elements, as well as some vitamins including vitamin C, A, and B-complex (Adebooye and Opunta 1996). Gujarat Anand Okra 5 variety released in 2011 at Main Vegetable Research Station, Anand. This variety give 14.1 t/ha green pod yield. Gujarat Okra 6 variety developed through pedigree method of selection in 2018 at Junagadh Agricultural University. It is suitable in *kharif* season and gives 12.5 tonne yield per hectare.

Micronutrients are important for plant as their deficiency and toxicity lead various disorders. Zinc is the most essential micronutrient which considered significant in activating number of enzymes. It is also needed by plant for formation tryptophan, which consists of the Indole Acetic Acid (IAA) hormones, which is necessary to cells elongate. While, the lack of zinc will affect the vital processes including the manufacture of carbohydrates and auxin production (Sidhu *et al.,* 2019). Its deficiency also causes interveinal chlorosis and reduce root growth as well as fruiting. The micronutrient iron (Fe) serves as a catalyst in the creation of the chlorophyll molecule, which aids in the uptake of other elements (Pandav *et al.,* 2016). Foliar application is a successful way to deliver nutrients during a time of intense plant growth, when it can enhance the mineral status of plants and boost crop yield (Maliha *et al.,* 2022; Biswas *et al.,* 2020 in onion; Kumar *et al*., 2021in okra and Sardar *et al*., 2021). Because chelated micronutrient will remain in a bio-available form for a lot longer time period, chelated fertiliser stability is advantageous and increases micronutrient use efficiency in vegetable production. Zinc and Iron can be apply in the form of $FeSO_4$, $ZnSO_4$, Fe EDDHA and Zn EDTA as a foliar spray. Therefore, the current investigation was carried out to learn more about response of varieties to foliar application of Zn and Fe for yield and quality parameters of okra.

MATERIALS AND METHODS

The experiment was carried out at the Horticultural Research Farm, College of Horticulture, Anand Agricultural University, Anand, Gujarat, India, during the *Kharif* season in the years 2020 and 2021. Which is located geographically at an elevation of approximately 45.1 m above mean sea level and is located at 22º35' North latitude and 72º56' East longitude. This region experiences a semi-arid subtropical climate. A factorial randomised block design was used in the experiment, which included three replications, fourteen treatment combinations, two varieties of okra (V_1: Gujarat Anand okra 5 and V_2: Gujarat okra 6) and seven level of foliar application of Zn and Fe [M_1: $FeSO_4$ @ 0.50 %, M_2: $ZnSO_4$ @ 0.50 %, M_3: Fe EDDHA @ 0.1 %, M_4: Fe EDDHA @ 0.2 %, M_5: Zn EDTA @ 0.1 %, M_6: Zn EDTA @ 0.2 % and M_7: Control (Water spray)]. The spacing was 60 × 30 cm apart, and the overall plot size was 3.6 x 3.0 m. The foliar application of Fe and Zn were sprayed in four frequencies at 30, 40, 50 and 60 DAS. The fertilizers 100:50:50 kg NPK/ha and the recommended dose of FYM 10 t/ha were used.

Observations of yield parameters were recorded from the five tagged plants and five pod per treatment were randomly selected for recording quality parameters. At the fourth plucking, five green pods from five randomly chosen tagged plants were weighed. The mean weight of the five green pods was determined and expressed in grammes. Each time a pod was picked from one of five tagged plants in a plot, the weight of the pod was recorded, added up, and the average weight per plant calculated and reported. Fiber and phenol content of pod was determined according to method suggested by Sadasivam and Manickam (1992). The DMSO (Di Methyl Sulphoxide) technique was used to quantify the amount of total chlorophyll in the pod (Hiscox and Israelstam 1979). Leaf membrane injury (LMI) was determined by using the method of Sullivan (1971). The pooled analysis was conducted in accordance with Panse and Sukhatme (1967) to examine the average effect of various treatments over time.

RESULTS AND DISCUSSION

A. Yield parameters of okra

Response of varieties. Maximum number of pods per plant (20.50), pod production per plant, and hectare (258.89 g and 13.91 tonne) showed a significant response for variety GAO 5 (Table 1). Whereas days to last picking and pod weight were remained non-significant. It might be due to genetical differences in varieties. Maliha *et al.* (2022), Badini *et al.* (2019); Tawab *et al.* (2015) observed similar findings in relation to okra and brinjal, respectively.

Response of foliar application to Zn and Fe. Treatment M6 (Zn EDTA @ 0.2%) resulted in the highest number of days till the last picking (96.93), number of pods per plant (21.35), pod weight (14.43 g) and pod yield per plant and hectare (269.44 g and 14.64 tonne). Picking period was extended might be due to foliar application of Zn and Fe may increases flower production, fertilization as well as pollen production that resulted more number of pods that ultimately extended picking period of okra crop. This result was supported by Chaudhari *et al.* (2018) in okra. Due to its role in the synthesis of tryptophan, the building block of a substance that promotes development, as well as the accelerated mobility of photosynthates from the source to the sink, the number of pods and flowers increases. These results are supported by Elayaraja and Singaravel (2017) in okra, Tariq *et al.* (2021) in onion and Londe *et al.* (2020) in tomato. Chelated zinc may have contributed to the increase in pod weight since it improves mineral utilisation while also boosting photosynthesis, metabolic activity, and the amount of food that is diverted to pods. The findings of Elayaraja and Singaravel (2017) in okra and Londe *et al.* (2020) in tomato are very similar to these observations.

Table 1: Response of varieties to foliar application of Zn and Fe on yield parameters of okra (Pooled of two years).

Code	Treatments	Days to last picking	Pod weight (g)	Number of pods per plant	Pod yield per plant (g)	Yield (t/ha)
Varieties (V)						
V_1	GAO 5	93.53	13.04	20.50	258.89	13.91
V_2	GO 6	91.77	12.56	16.38	209.20	11.81
	S.Em.±	0.91	0.17	0.21	2.64	0.15
	CD at 5 %	NS	NS	0.61	7.49	0.41
Foliar application of Zn and Fe (M)						
M_1	$FeSO_4$ @ 0.50 %	90.07	11.92	16.85	211.90	11.73
M_2	$ZnSO_4$ @ 0.50 %	91.08	12.29	17.41	222.68	11.82
M_3	Fe EDDHA @ 0.1 %	92.59	12.68	18.34	232.81	13.63
M_4	Fe EDDHA @ 0.2 %	96.28	13.67	20.18	260.01	14.21
M_5	Zn EDTA @ 0.1 %	95.12	13.14	18.69	240.93	13.95
M_6	Zn EDTA @ 0.2 %	96.93	14.43	21.35	269.44	14.64
M_7	Control (water spray)	86.46	11.47	16.22	200.52	10.03
	S.Em.±	1.70	0.32	0.40	4.94	0.27
	CD at 5 %	4.84	0.91	1.14	14.01	0.77
Interaction (V × M)						
	S.Em.±	2.41	0.46	0.57	6.98	0.39
	CD at 5 %	NS	NS	Sig.	NS	NS
	CV (%)	6.38	8.72	7.55	7.31	7.34

The improvement in pod yield per plant may be attributed to Zn EDTA's action, which increased photosynthetic activity and led to the generation and accumulation of carbohydrates and necessary auxins, which increased pod weight and number per plant and, in turn, led to higher pod output. Elayaraja and Singaravel (2017); Datir *et al.* (2010) for okra, and Londe *et al.* (2020) for tomato all support these findings.

Interaction effect (V × M). Interaction effect of variety GAO 5 and foliar application of Zn EDTA @ 0.2 % recorded maximum number of pods per plant (24.22) (Table 3). This might be due to varietal influence and the synthesis of tryptophan, the precursor of the growth promoting substance and also acceleration in mobility of photosynthates from the source to the sink that enhances numbers of pods per plant. Elayaraja and Singaravel (2017) reported similar effects with okra, and Londe *et al.* (2020) with tomato.

B. Quality parameters of okra

Response of varieties. Varieties significantly affected on quality parameters of okra (Table 2). The maximum fiber content of pod (2.56 %), chlorophyll content of pod (0.496 mg/100 g), phenol content of pod (0.122 %) and minimum leaf membrane injury (32.72 %) was observed with variety GAO 5. It might be due to genetical differences in varieties. Maliha *et al.* (2022); Badini *et al.* (2019); Tawab *et al.* (2015) reported similar results for okra and brinjal, respectively.

Response of foliar application of Zn and Fe. The maximum fiber content of pod (2.62 %), chlorophyll content of pod (0.504 mg/100 g), phenol content of pod (0.119 %) and minimum leaf membrane injury (26.92 %) was observed with treatment M6 (Zn EDTA @ 0.2 %). This might be due to foliar application of Zn provide the better increase accumulation of starch reserve in developing pod resulted in higher fiber content in okra pod. These findings closely match those of Singh (2006); Sharma *et al.* (2018) with regards to okra. Zinc is an important component for development of chloroplast and it plays a prominent role in photosynthesis which helps in production of chlorophyll content of okra pod as well as develop resistant to abiotic and biotic stresses, protection against oxidative damage, membrane integrity and phytochrome activities which resulted into reduction of leaf membrane injury. Singh (2006); Sharma *et al.* (2018) in okra support these findings.

Table 2: Response of varieties to foliar application of Zn and Fe on quality parameters of okra (Pooled of two years).

Code	Treatments	Fiber content of pod (%)	Chlorophyll content of pod (mg/100 g)	Phenol content of pod (%)	Leaf membrane injury (%)
Varieties (V)					
V_1	GAO 5	2.56	0.496	0.122	32.72
V_2	GO 6	2.32	0.470	0.104	35.25
	S.Em.±	0.02	0.002	0.001	0.08
	CD at 5 %	0.06	0.006	0.002	0.24
Foliar application of Zn and Fe (M)					
M_1	$FeSO_4$ @ 0.50 %	2.33	0.473	0.108	37.71
M_2	$ZnSO_4$ @ 0.50 %	2.39	0.473	0.111	35.36
M_3	Fe EDDHA @ 0.1 %	2.41	0.482	0.113	33.79
M_4	Fe EDDHA @ 0.2 %	2.56	0.495	0.117	30.86
M_5	Zn EDTA @ 0.1 %	2.48	0.491	0.115	31.88
M_6	Zn EDTA @ 0.2 %	2.62	0.504	0.119	26.92
M_7	Control (water spray)	2.28	0.462	0.105	41.36
	S.Em.±	0.04	0.004	0.001	0.16
	CD at 5 %	0.12	0.012	0.004	0.45
Interaction (V × M)					
	S.Em.±	0.06	0.006	0.002	0.22
	CD at 5 %	NS	Sig.	NS	NS
	CV (%)	5.87	2.96	3.81	1.61

Interaction effect (V × M). The interaction between variety and foliar Zn and Fe application had no discernible influence on fibre content, phenol content or leaf membrane damage. Whereas, maximum chlorophyll content of pod (0.509 mg/100 g) was observed with combine effect of variety GAO 5 and foliar application of Zn EDTA @ 0.2 %. This might be due to genetic makeup of variety and Zn which is important component for development of chloroplast and it plays a prominent role in photosynthesis which helps in production of chlorophyll content of okra pod. While, moisture content, fiber content, phenol content and leaf membrane injury was found non-significant. Singh (2006); Sharma *et al.* (2018) in okra support these findings.

Table 3: Interaction effect of varieties and foliar application of Zn and Fe on number of pods per plant and chlorophyll content of okra pod (Pooled of two years).

Foliar application of Zn and Fe (M)		Number of pods per plant		Chlorophyll content of pod (mg/100 g)	
		Varieties (V)		Varieties (V)	
		V_1 (GAO 5)	V_2 (GO 6)	V_1 (GAO 5)	V_2 (GO 6)
M_1	$FeSO_4$ @ 0.50 %	18.01	15.70	0.489	0.458
M_2	$ZnSO_4$ @ 0.50 %	18.92	15.90	0.489	0.457
M_3	Fe EDDHA @ 0.1 %	20.27	16.42	0.489	0.475
M_4	Fe EDDHA @ 0.2 %	23.42	16.95	0.505	0.485
M_5	Zn EDTA @ 0.1 %	20.89	16.48	0.503	0.480
M_6	Zn EDTA @ 0.2 %	24.22	18.48	0.509	0.499
M_7	Control (water spray)	17.74	14.70	0.487	0.438
S.Em.±		0.57		0.006	
C. D at 5 %		1.61		0.017	
CV %		7.55		2.96	

CONCLUSIONS

From the two years of field study, it can be concluded that variety GAO 5 found better with regards to yield and quality parameters and foliar application of Zn EDTA @ 0.2 % at 30, 40, 50 and 60 days after sowing improves yield parameters as well as quality of okra pods. Combining the effects of variety GAO 5 and foliar Zn EDTA @ 0.2% spray increases okra pod length, number of pods per plant, and chlorophyll content of pod.

FUTURE SCOPE

In order to increase yield and quality in okra, future studies have to be done further by employing the different form of foliar application of Zn and Fe to different varieties of okra

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Conflict of Interest. None.

REFERENCES

Adebooye, C. O. and Opunta, C. O. (1996). Effect of gelex on growth and fruit nutrient composition of okra [*Abelmoschus esculentus* (L.) Moench]. *Int. foodeng. J. Agric.*, *18,* 1-9.

Badini, M. A., Qadir, G., Jakhro, M. I., Aziz, T., Ahmed, S., Mengal, M. I., Saleem, M., Abro, A. J. and Ahmed Shah, S. I. (2019). Response of okra verities, to zinc and boron supplement under the agro-climatic condition of Tandojam-Pakistan. *Pure and Applied Biology, 1*(8), 601-608.

Biswas, P., Das, S., Bar, A., Maity, T. K. and Mandal, A. R. (2020). Effect of micronutrient application on vegetative growth and bulb yield attributes of *rabi* onion (*Alliumcepa* L.). *Int. J. Curr. Microbiol. App. Sci.*, *9*(3), 556-565.

Chaudhari, S. P., Patel, G. S., Acharya, S. K., Vadodaria, J. R., Chaudhary, S. B. and Chaudhari, M. P. (2018). Effect of integrated nutrient management (INM) on growth and yield of okra (*Abelmoschus esculentus* L Moench) cv. GAO 5 under North Gujarat condition. *International Journal of Agriculture Sciences*, *20*(10), 7361-7363.

Datir, R. B., Laware, S. L. and Apparao, B. J. (2010). Effect of organically chelated micronutrients on growth and productivity in okra. *Asian J. Exp. Biol. Sci.,* SPL, 115-117.

Elayaraja, D. and Singaravel, R. (2017). Effect of different levels and sources of zinc fertilizers on the growth and yield of okra in coastal sandy soil. *International Journal of Agricultural Sciences*, *2*(13), 282-287.

Hiscox, J. D. and Israelstam, G. F. (1979). A method for extraction of chlorophyll from leaf tissue without maceration. *Canadian Journal of Botany*, *57*, 1332-1334.

Kumar, V., Deo, C., Sarma, P., Wangchu, L., Debnath, P., Singh, A. and Hazarika, B. (2021). Effect of foliar application zinc and boron on vegetative growth characters of okra. *Journal of Pharmacognosy and Phytochemistry*, *10*(1), 2084-2086.

Londe, M. B., Kshirsagar, D. B. and Shinde, S. R. (2020). Effect of plant growth regulators and micronutrients on growth and fruit setting, fruit retention and yield of tomato (*Solanum lycopersicum* L.) during summer season. *An International Refereed, Peer Reviewed & Indexed Quarterly Journal in Science, Agriculture & Engineering*, *10*(33), 511-513.

Maliha, M. B. J., Nuruzzaman, M., Hossain, B., Trina, F. A., Uddin, N. and Sarker, A. K. (2022). Assessment of varietal attributes of okra under foliar application of zinc and boron. *International Journal of Horticultural Science and Technology*, *9*(2), 143-149.

Pandav, A. K., Nalla, A. T., Rana, M. K. and Bommesh, J. C. (2016). Effect of foliar application of micronutrients on growth and yield parameters in eggplant cv. HLB 12. *Environment and Ecology*, *35*(3), 1745-1748.

Panse, V. G. and Sukhatme, P. V. (1967). Statistical methods for agricultural workers. *Indian Council of Agricultural Research,* New Delhi.

Sadasivam, S. and Manickam, A. (1992). Biochemical methods for agricultural sciences. Wiley Eastern Ltd., New Delhi.

Sardar, H., Naz, S., Ejaz, S., Farooq, O., Rehman, A., Javed, M. S. and Akhtar, G. (2021). Effect of foliar application of zinc oxide on growth and photosynthetic traits ofcherry tomato under calcareous soil conditions. *Acta Sci. Pol. Hortorum Cultus, 20*(1), 91–99.

Sharma, L. N., Bairwa, A. L., Ola, K. L. and Atmaram, M. (2018). Effect of zinc on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench] cv. Parbhani Kranti, *Journal of pharmacognosy and Phytochemistry*, *7*(1), 2519-2521.

Sidhu, M. K., Raturi, H. C., Kachwaya, D. S. and Sharma, A. (2019). Food security, nutrition and sustainable agriculture-emerging technologies. *Journal of Pharmacognosy and Phytochemistry*, 332-340.

Singh, S. (2006). Effect of bioregulators and zinc on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench.]. Rajasthan Agricultural University, Bikaner S. K. N. College of Agriculture, Jobner.

Sullivan, C. Y. (1971). Techniques for measuring plant drought stress. In drought injury and resistance in crops, Ed. K. L. Larson and J. D. Eastin, *Crop Science Society of America,* Madison, Wisconsin, pp. 1-18.

Tariq, M., Ali, R., Khan, M. O., Hussain, A., Murad, Z., Ali, M., Khalil, M. K. and Muhammad, S. (2021). Impact of soil and foliar application of various zincsources on the yield and uptake by onion under agroclimatic condition of Swat.*Int. J. Agricult. Stat. Sci., 17*(1), 2363-2376.

Tawab, S., Ayub, G., Tawab, F., Khan, O., Bostan, N., Ruby, S., Ahmad, S. and Afridi, U. (2015). Response of brinjal (*Solanum melongena* L.) cultivars to zinc levels. *J. Agri. and Bio. Sci., 10*(5), 171-178.

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