Madras Agric. J. 89 (4-6) : 234-237 April-June 2002
https://doi.org/10.29321/MAJ.10.A00207

Studies on the effect of zinc and iron on yield and nutrition of sama (*Panicum sumetrense* Roth.) in rainfed Entisol

V.P. DURAISAMI AND A.K.MANI
Regional Research Station, Tamil Nadu Agricultural University, Paiyur - 635 112, Tamil Nad

Abstract : **Field experiments conducted in a red loamy sand soil (Typic Ustorthent) to study the effect of zinc and iron on samai revealed that the samai responded well to the application of micronutrients and the highest grain yield of 835 kg ha^{-1} registered at $ZnSO_4$@ 20 kg ha^{-1} with $FeSO_4$ @ 10 kg ha^{-1}. The same two levles also individually accounted for higher mean net return. The availability of Fe increased with Fe levels while application of Zn decreased the availability of Fe in the soil.**

Key words : Iron, Zinc, Yield, Uptake, Net return.

Introduction

Samai is one of the important minor millets predominantly grown in the red soils of north western zone of Tamil Nadu under rainfed conditions. High degree of drought tolerance, relatively shorter duration, less cost of cultivation etc., this crop holds greater significance in this region. A few research works on the nutrient management conducted else where in the country have proved that better yields could be obtained from minor millets even with little attention on the nutritional aspects. However, the works on the micronutrients requirement on yield and nutrition of samai is sporadic. Hence, an attempt has been made to assess the effect of iron and zinc on the yield and economics of samai and residual fertility in the red soils under rainfed conditions.

Materials and Methods

Experiments were carried out during 1997-98 in a red loamy sand soil (Typic Ustorthent) with pH 7.96, EC 0.42 dSm^{-1}, low in available N (163.0 kg ha^{-1}), medium in available P (12.0 kg ha^{-1}) and high in available K (370.0 kg ha^{-1}). The DTPA extractable Zn and Fe were 0.92 and 5.2 ppm, respectively, Samai var. Paiyur^{-1} was used at test crop. The treatments included three levels of Zn and Fe each (0, 10 and 20 kg $ZnSO_4$ and $FeSO_4$ ha^{-1} respectively) in a factorial randomized block design with three replications. A common dose of 40: 20: 0 kg ha^{-1} of N, P_2O_5 and K_2O in the form of urea and super phosphate was applied basally to all the plots. The $ZnSO_4$ and $FeSO_4$ as per treatment schedule was also given in a single dose through surface application. The yield of grain and straw was recorded at harvest and net return and B/C ratio worked out. The grain and straw samples were digested in tri acid mixture (HNO_3 : $HClO_4$: H_2SO_4) and analysed for Zn and Fe contents in atomic absorption spectro photometer (AAS). The soil samples collected (0-15 cm depth) were analysed for DTPA extractable Zn and Fe (Lindsay and Norvell, 1978). The data were subjected to statistical scrutiny (Snedecor and Cochran, 1968).

Results and Discussion

Yield and Economics

The main effect of Zn and Fe as well as their interactions had a profound influence in increasing the grain yield. Application of 20 kg $ZnSO_4$ ha^{-1} recorded mean yield of 814 kg ha^{-1} proving its superiority over the other levels accounting for an yield improvement of 10.0 and 7.1 per cent, respectively over zero and 10 kg $ZnSO_4$ ha^{-1} (Table 1). Similar yield increase at 20 kg $ZnSO_4$ ha^{-1} was observed by Puste and Tana (1995) in pigeon pea and Patel and Patel (1988) in sorghum. Among the Fe levels, the response was only upto 10 kg $FeSO_4$ ha^{-1} and the grain yield declined there after. The interaction indicated the more beneficial nature of combined use of 20 kg $ZnSO_4$ with 10 kg $FeSO_4$ ha^{-1} with yield of 835 kg ha^{-1}. The combination of 20 kg $ZnSO_4$ ha^{-1} + 20 kg $FeSO_4$ ha^{-1} rated next best by recording almost equal grain yield of 833 kg ha^{-1}. These two treatments increased the grain yield to the tune of 22.6 and 22.3 per cent over no micronutrient application. Yield increase in mint due to Fe and Zn application was reported by Nair *et al.* (1992).

The straw yield variations were significant only due to the Fe levels (Table 1). Similar to grain yield, application of 10 kg $FeSO_4$

Table 1. Effect of Zn and Fe on yield of samai

Levels	Grain yield (kg ha^{-1})				Straw yield (kg ha^{-1})			
	Fe_0	Fe_{10}	Fe_{20}	Mean	Fe_0	Fe_{10}	Fe_{20}	Mean
Zn_0	681	783	755	740	1328	1718	1508	1518
Zn_{10}	775	808	697	760	1482	1555	1595	1544
Zn_{20}	775	835	833	814	1473	1688	1758	1640
Mean	744	809	762		1428	1654	1621	-
Source	Zn	Fe	Zn x Fe		Zn	Fe	Zn x Fe	
CD (P =0.05)	37.4	37.4	64.8		NS	209.7	NS	

Table 2. Effect of treatments on economics in samai

Levels	Net return (Rs. ha^{-1})				B/C ratio			
	Fe_0	Fe_{10}	Fe_{20}	Mean	Fe_0	Fe_{10}	Fe_{20}	Mean
Zn_0	1977	2427	2107	2170	2.17	2.32	1.93	2.14
Zn_{10}	2307	2349	1664	2107	1.81	2.17	1.78	1.92
Zn_{20}	2136	2340	2207	2228	2.05	2.08	1.96	2.03
Mean	2140	2372	1993	-	2.01	2.19	1.89	-

Table 3. Effect of Zn and Fe on Zn content (ppm)

Levels	Grain				Straw			
	Fe_0	Fe_{10}	Fe_{20}	Mean	Fe_0	Fe_{10}	Fe_{20}	Mean
Zn_0	38.1	40.8	47.4	42.1	20.6	56.3	19.7	32.2
Zn_{10}	61.2	42.3	52.8	52.1	23.8	51.8	51.4	42.3
Zn_{20}	53.8	51.7	54.8	53.4	25.6	40.0	56.2	40.6
Mean	51.0	44.9	51.6	-	23.3	49.4	42.4	-
Source	Zn	Fe	Zn x Fe		Zn	Fe	Zn x Fe	
CD (P =0.05)	4.28	4.28	7.42		3.86	3.86	6.68	

ha^{-1} though on par with 20 kg ha^{-1}, recorded its superiority over no Fe application by recording 1654 kg ha^{-1} of straw.

The net return due to Zn level at 20 kg ha^{-1} was relatively more (Rs.2228 ha^{-1}) as against Rs.2107 ha^{-1} at 10 kg level and Rs.2170 ha^{-1} at zero level (Table 2), A net income of Rs.2140 ha^{-1} under no Fe application got increased to Rs.2372 ha^{-1} at 10 kg $FeSO_4$. However, further increase in Fe level (20 kg ha^{-1}) was found to be un economical and infact the net return fall even below Fe_0. The B/C ratio also followed a similar trend as that of net income and again Zn_{20} and Fe_{10} exhibited their superiority over other levels.

Micronutrients content

The Zn content in the grain varied significantly among the Zn levels and application of 20 kg $ZnSO_4$ ha^{-1} recorded the maximum of 53.4 ppm followed by 52.1 and 42.1 ppm recorded at 10 and zero kg $ZnSO_4$ ha^{-1} (Table 3). However, among the Fe levels, a value of 510 ppm in Fe_0 got significantly reduced to 449 ppm at 10 kg ha^{-1} and at 20 kg ha^{-1}, though the content increased to 516 ppm it was almost equivalent to control (Fe_0). The interaction effect revealed that application on Zn at 10 and 20 kg ha^{-1} at all levels of Fe could account for better Zn content than no Zn application.

In the straw, the mean Zn content among Zn levels ranged from 32.2 to 42.3 ppm and the two applied levels were at par with each other however significantly superior over Zn_0 level. It clearly indicates that application of Zn either 10 or 20 kg ha^{-1} could improve the Zn content favouring better nutrition of the crop. Higher concentration of Zn due to $ZnSO_4$ application was reported by Patel and Patel (1988) in forage sorghum.

The Fe content in the grain exhibited an increasing trend with increasing levels of Zn and it ranged from 941 to 1475 ppm and the level of 20 kg $ZnSO_4$ ha^{-1} proved its over riding superiority over other levels (Table 4). It is obvious that with successive Fe levels, the content in the grain got increased significantly. A value of mere 854 ppm under Fe_0 got enhanced to 1111 ppm at 10 kg ha^{-1} and to 1450 ppm at 20 kg ha^{-1} Combined application of 20 kg each of Zn and Fe accounted for 1782 ppm in the grain as against 718 ppm under no fertilizer application indicating the positive response of samai to Zn and Fe.

The straw Fe exhibited a declining trend upto 10 kg $ZnSO_4$ ha^{-1} and increased to the maximwn of 1003 ppm at 20 kg ha^{-1}. The decrease at 10 kg level may be due to dilution effect and the increase in content there after may be ascribed to the nullification. The Fe levels could improve the content from 790 to 992 ppm among

Table 4. Effect of Zn and Fe on Fe content (ppm)

Levels	Grain				Straw			
	Fe_0	Fe_{10}	Fe_{20}	Mean	Fe_0	Fe_{10}	Fe_{20}	Mean
Zn_0	718	931	1173	941	851	966	827	881
Zn_{10}	751	851	1394	998	716	705	651	691
Zn_{20}	1092	1550	1782	1475	803	1006	1289	1033
Mean	854	1111	1450	-	790	892	922	-
Source	Zn	Fe	Zn x Fe		Zn	Fe	Zn x Fe	
CD (P=0.05)	126.1	126.1	218.4		108.8	108.8	188.5	

Table 5. Effect of Zn and Fe on available micronutrients (ppm)

Levels	DTPA-Zn				DTPA-Fe			
	Fe_0	Fe_{10}	Fe_{20}	Mean	Fe_0	Fe_{10}	Fe_{20}	Mean
Zn_0	0.60	0.73	0.83	0.716	4.95	7.66	9.33	7.31
Zn_{10}	0.82	0.86	0.68	0.787	4.12	5.45	7.82	5.80
Zn_{20}	0.85	1.21	1.16	1.073	3.84	4.13	5.90	4.62
Mean	0.757	0.933	0.889	-	4.30	5.75	7.68	-
Source	Zn	Fe	Zn x Fe		Zn	Fe	Zn x Fe	
CD (P=0.05)	0.141	0.141	0.244		0.96	0.96	1.39	

s levels. and the magnitude of variation was ider between 0 and 10 kg ha^{-1}.

vailable micronutrients status

The available Zn (DTPA - extractable) nged from 0.716 to 1.073 ppm and the Zn vel at 20 kg ha^{-1} ranked first in leaving behind e soil more Zn with the highest availability f 1.073 ppm and no significant differences bserved between 0 and 10 kg ha^{-1} (Table 5). pplication of Zn resulted in an increase of vailable Zn was earlier reported by Nair *et al.* 992). Albeit an increase in values of available n with 10 kg $FeSO_4$ ha^{-1}, the availability declined 20 kg $FeSO_4$ ha^{-1} and was at par with Fe_0. owever, the coupled application of 20 kg $ZnSO_4$ th 10 kg $FeSO_4$ ha^{-1} rated to be the best mbination by recording 1.21 ppm of Zn against ly 0.60 ppm at zero level.

The available Fe as influenced by Zn levels vealed that the Zn applied treatments *viz.* 10 d 20 kg ha^{-1} decreased the availability of to 5.80 and 4.62 ppm, respectively from 7.31 m at Zn_0 level (Table 5). Zinc and Fe have most the same ionic radii and thus compete Krauskopf, 1972) for the same exchange sites r Zn may replace Fe from clay silicate structure f soil. In respect of Fe levels, the availability f Fe was significantly increased and the higher alue of 7.68 ppm registered at 20 kg $FeSO_4$ a^{-1} followed by 10 kg ha^{-1} (5.75 ppm) as against zero level (4.30 ppm). The interaction revealed that irrespective of the levels, the Fe application improved the available Fe while it decreased with application of Zn.

Hence, it may be concluded that samai responded well to micronutrients application upto 20 kg $ZnSO_4$ and 10 kg $FeSO_4$ ha^{-1} in the rainfed red soils of north western zone of Tamil Nadu.

References

Krauskoff, K. (1972). In micronutrients in Agriculture. Soil Science Society of America. Madison, Wisconsin, U.S.A.

Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* **42:** 421-428.

Nair, A.K., Subrahmanyam, K., Verma, B.S. and Singh, D.V. (1992). Response of Japanese mint to Fe and Zn at two fertility levels. *J. Indian Soc. Soil Sci.* **40** : 873-875.

Puste, A.M. and Tana, P.K. (1995). Effect of phosphorus and zinc on the yield attributes and yield of pigeon pea varieties grown during winter season. *Madras Agric. J.* **82:** 348-351.

Patel, P.C. and Patel, J.R. (1988). Effect of zinc with and without organic manures on growth and zinc nutrition of different genotypes of forage sorghum. *J. Indian Soc. Soil Sci.* **36:** 820-822.

Snedecor, G.W. and Cochran, W.G. (1968). Statistical methods. Oxford and IBH Publishing Company. New Delhi.

(Received: December 2000; Revised: May 2001)