

(Triticum aestivum L.)

1 1

(Cu Zn Fe)

(T2) (99) (T1) :

(T7) (T6) (T5) (T4) (T3)

(T1) (T8)

(T8)

% 109 38.1 38 28.3 38.5 11.4

) T8 (

T7 N, P, K, Fe, Zn, Cu

% 71

% 11 % 63

(99) /

B₁

B₂

gliding

gluteinin

(Triticum aetivum L.)

.(1992

1987

)

(1

.2010/6/14

2009/6/24

.(1994

)

Vallace & Falchuk, 1991; Jones, 1995;)
(Gobara, 1998; Brayon, 1999; Focus, 2003

(2001)

:
-1
.99 / (micronutrients)
-2 K P
K N
. P N

2008 / 2007

- -
(Cu, Zn, Fe) ; Khan & Jamil, 1998; 2000)
(Mingle and Kirkby, 1982; Whitehead, 2000

99 / .(Yagodin, 1984)

/ Bergmann, 1983)
() .(2006 1988 1987

(1)

(Page et al., 1982 Black, 1965)

(Cu, Zn, Fe)

; Lombim,1983 ; 1988)

/ .(2005

(Trieweiler and Lindsay, 1969)

1- . 50 (Fe) :
25 (Zn) (Fe % 20)
(Zn % 35) 1- .
1- . 25 (Cu)

(/ 130) / 0.3 (Cu % 24.8)
)
 2007 /11 /28 .(
 (N % 46) 20) (28) (28)
 / 1 (9) ()
 (CRD)
 (P₂O₅ 45%)
 (/ 200) / 1
 (K₂O % 42) K₂SO₄
 .(2) (45)

.1

	1.65	EC
¹⁻ .		
pH	7.3	
¹⁻ .	131	
¹⁻ .	15.2	
¹⁻ .	138	
%	1.2	
%	37.5	
%	52.5	
%	10.0	
-		
¹⁻ .	4.20	
¹⁻ .	1.04	
¹⁻ .	3.02	

		.2				
		/()				
		-				T ₁
		50		/ 50		T ₂
		25		/ 25		T ₃
		25		/ 25		T ₄
	50+	25	/ 50+	/ 25		T ₅
	50+	25	/ 50+	/ 25		T ₆
	25+	25	/ 25+	/ 25		T ₇
50+	25+	25	/ 25+	/ 25		T ₈
				/ 50+		

* * =
 . 0.95 0.95 1- .³ 0.15
 b a))
 (Witham *et al.*, 1971) (99) / (2001
 (Sawhuwy and Randhir, 2000) (15) 2007/11/18
 25 (5)
 : (7)
 =
 . (A.A.C.C., 2000) 5.7 * 45
 60 (50)
 (Sawhuwy and Randhir, 2000) 90 75
 .(Chapman and Pratt, 1961) 100
 (Cu, Zn, Fe)
 (Trieweiler and Lindsay, 1969) 40
 /
 .(Joslyn , 1970)
 1000 (Liang *et al.*, 1973)
 .(10) 100 105 (Thomas, 1975)
 :

Least (L.S.D.5%)
Significant Difference
Analysis of Variance
(Zar , 1999)

(/)
39 (/)
/ 2.9 /² 22.2 /
% 37 26 11
(3) T₁

(/)
(/)
/ 28.8 / 6.9 / 2.3 T₈
38 36 109
(4) % () T₇

(Cu, Zn, Fe)
99 /
(Fe+Zn+Cu)

.3

.99 /

(/)	(/ ²)	(/)	
2.1	17.3	35.0	T ₁
2.2	19.6	35.8	T ₂
2.5	20.2	37.0	T ₃
2.4	18.4	36.6	T ₄
2.7	21.0	38.4	T ₅
2.5	20.8	37.6	T ₆
2.8	22.0	38.8	T ₇
2.9	22.2	39.0	T ₈
0.08	1.08	0.81	LSD _{P≤0.05}

.4

.99 /

(/)	(/)	(/)	
20.8	5.0	1.1	T ₁
21.3	5.6	1.6	T ₂
26.0	6.3	1.6	T ₃
25.0	5.9	1.5	T ₄
27.9	6.8	1.9	T ₅
26.1	6.4	1.7	T ₆
27.9	6.3	1.6	T ₇
28.8	6.9	2.3	T ₈
0.46	0.52	0.36	LSD _{P≤0.05}

Cu,)

a b a

T₈

(Zn ,Fe

/ (4.83 1.51 3.32) + b

.99 /

% 11 % 17 % 9

.(5)

T₈

b

a

.5

.99 /

(/)	b (/)	a (/)	
4.34	1.29	3.05	T ₁
4.61	1.36	3.25	T ₂
4.52	1.33	3.20	T ₃
4.46	1.31	3.15	T ₄
4.70	1.43	3.28	T ₅
4.68	1.42	3.26	T ₆

(/)	b (/)	a (/)	
4.67	1.41	3.26	T ₇
4.83	1.51	3.32	T ₈
0.11	0.02	0.05	LSD $P \leq 0.05$

T₇ (6)

10.2
%79

13.6
%78

T₈

1-

9.0
% 63

% 0.39
% 21

% 3.42)

T₈

(% 2.67
%63 % 26

(7)

7

.6

.99 /

(%)	(%)	(%)	
1.63	0.31	2.81	T ₁
2.12	0.34	3.12	T ₂
2.08	0.33	3.13	T ₃
2.02	0.36	3.12	T ₄
2.58	0.37	3.28	T ₅
2.38	0.36	3.24	T ₆
2.33	0.37	3.15	T ₇
2.67	0.39	3.42	T ₈
0.28	0.02	0.26	LSD $P \leq 0.05$

.7

.99		/	
/	/	/	
5.5	5.7	7.6	T ₁
6.2	6.8	9.1	T ₂
6.5	7.6	9.8	T ₃
7.8	6.3	8.4	T ₄
8.1	8.7	11.6	T ₅
7.8	8.1	10.7	T ₆
8.8	8.5	11.3	T ₇
9.0	10.2	13.6	T ₈
0.59	1.46	1.9	LSD _{P≤0.05}

(8)

T ₈	%63	%15.2		(76.3 %)
(Zn +Fe)T ₅			%11.8	T ₈
			.(68.2 %)	
		%14.7	(%74.2)	T ₅
(Cu)T ₄		%57.97		% 8.7
% 11.5				T ₄
		%23.77	%69.9	
%.9.3				%2.5

.8

.99 /	
(%)	(%)
9.3	68.2
12.1	72.6
11.9	71.6
11.5	69.9
14.7	74.2
13.6	74.0
13.3	73.0
15.2	76.3
1.46	1.33

9.8

Cu,) / (Zn, Fe 99	
(%)	(%)
71.71	5.7
T8 (T7, T6, T5)	31.9
1000	1000
1000	16.27
1000	9

1000 /	
(/)	()
5.7	27.4
7.4	30.1
9.7	31.1
7.1	30.0
9.7	31.5
8.7	31.1

(/)	1000 ()	
9.7	31.4	T ₇
9.8	31.9	T ₈
1.5	2.4	LSD P≤0.05

Cakmak and) ()
 Marschner, 1993; Suge et al., 1986; Coleman,
 .(1992; Cakmak et al., 1998

(Fe + Zn + Cu) T₈

(2000) (1997)
 .Vinod et al. (1990)

.(2003)
 (Cu, Zn,

(Fe

Tryptophan
 .(Cakmak et al., 1998)

(2008)

6

4

Goods et al. (2000)

(1993 1988)
 Beckett and Davis, 1978; ; Selim, 1994)

.(Bergmann, 1992

.(Abd-El-Hadi et al., 1990)

.(2006)

(Mengel and Kirby, 1982; Pamila and Dipak, 1977 1988

(Tryptophan)
 (Indole Acetic Acid IAA)

K, P, N

% 71
% 63

(Cu ,Zn, Fe) % 11

DNA RNA
(1988)
(Mengle & Kirkby, 1982; Focus, RNA 2003)

(2004)
(Yoshida *et al.*, 1970)

Evans & Wardlaw, 1976; Harder *et al.*,)
(2003 1982
) /
(99

-13

.2000/11/17

2001

.138-122 :(1)1
1988

2003

1997

.105-98:(1)3

2008

(3)
.60-51:(1)28

2006

2006

Citrus sinensis

.22-15:(2) 37

N15

2000

1987

Sorghum

bicolor L.

1993

(*Triticum aestivum* L.)

1994

.14-8:(1)24

2001

.85-80

2000

.18-16 :(4)5

()

2004

1999

.2 ()

2003

1992

.36-31 :(6)34

2005

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The Effect of Foliar Application of Some Microelements on Growth and Productivity of Wheat (*Triticum aestivum* L.)

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ABSTRACT

This experiment was conducted in pots to study the effects of foliar application of microelements (Cu, Zn and Fe) on some morphological, physiological and productivity characters of wheat (Ibaa cultivar). The experiment contained the following treatments: control (T1), iron sulfate (T2), zinc sulfate (T3), copper sulfate (T4), iron + zinc (T5), iron + copper (T6), zinc + copper (T7) and iron + zinc + copper (T8). All microelement treatments showed significant increase in all morphological, physiological and productivity characters compared with the control treatment. T8 treatment gave significant increase as compared to other treatments in all morphological characters (height of plant, leaf number, leaf area, branch number, total dry weight for shoots and roots). It gave increases by 11.4, 38.5, 28.3, 38, 38.1 and 109 %, respectively compared with the control. The T8 treatment also gave significant values in all physiological characters (chlorophyll, concentrations of N, P, K, Fe, Zn, Cu, starch and protein in grains) as compared to other treatments and the control treatment except with treatment T7, where there was no significant difference in P % and Fe % in grains. T8 gave increases in grain yield, protein and starch in grains by 71, 63 and 11 %, respectively compared to the control treatment. It is concluded that wheat cultivar (Ibaa) gave a clear response to foliar application with microelements Fe, Zn and Cu. Treatments of combinations between two elements together came second while treatments with each element alone came third. The results gave an indicator to use more than one element in foliar application in many bathes under a sprinkler irrigation system.

Keywords: Foliar application, Fe, Zn, Cu, Wheat crop.

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Received on 24/6/2009 and Accepted for Publication on 14/6/2010.