

Sorghum bicolor

L.

/

2004

2 1 0.5 0) (Zn%35) ¹⁻ .ZnSO₄.H₂O (2 1 0)
 (Fe 20%) ¹⁻ . FeSO₄.7H₂O (

(R.C.B.D)

(12)

¹⁻ . K 66.4 ¹⁻ .P 96 ¹⁻ .N 160

()

¹⁻ . FeSO₄.7H₂O 1 ¹⁻ .ZnSO₄.H₂O 1

¹⁻ .ZnSO₄.H₂O 2

Effect Of Zinc and Iron foliar fertilization on growth and yield of sorghum and its leaves and seed content of Zinc and iron

Fawzi Mohsin Ali & Haneen.S.Sharqi
 college of Agriculture/university of AL-Anbar

Abstract

A field experiment was conducted in eastern Husiba (16Km east of Ramadi) during 2004 to study the effect of foliar nutrition of sorghum with zinc in concentraten (0,1,2) gm ZnSO₄.H₂O.L⁻¹ (35%Zn) and iron in concentration (0,0.5,1,2) gm FeSO₄.7H₂O.L⁻¹ (20% Fe) and interaction with it on growth and yield and iron and zinc content of sorghum variety "Inqath" . A factorial experiment was implemented according to randomized complete block design(R.C.B.D).A total of 12

treatment with three replicates were randomly assigned. Nitrogen ,phosphorus and potassium were added as urea ,super phosphate and potassium sulfate in doses (160kg N, 96kg P and 66.4 kg K).h⁻¹ respectively on all experiment treatment. Zinc and Iron solution were sprayed in early morning at two stages ;vegetative growth and flowering stage. Plant height ,leaf area, dry matter yield, seed yield and its components were determined. Grain and leaves contents of zinc and iron were measured.

The result showed:

Zinc and iron (1gm.L⁻¹ of ZnSO₄.H₂O and 1gm.L⁻¹ of FeSO₄.7H₂O) showed significant increase in plant height, leaf area, dry matter, seed yields and its components. All levels of zinc sprayed significantly affected sorghum leaves and seed contents of zinc. The highest zinc content in seed was resulted from spray treatment with zinc at 2gm.L⁻¹. All levels of iron sprayed significantly affected sorghum leaves and seed content of iron.

Carbonic Anhydarse

.Enolase

IAA (Indole Acetic Acid)

(Trypto Phane)

(1990)

.Zn 10

(1992) Fox Rashid

. (1989)

1-

(1993) Tandon

1-

.Zn 115 5

1- . Zn 30 15

(1993) Tandon

1-

. Fe 100-65

(1982 Clark)

(1982) Clark

.(1974

Randhawa)

ZnSO₄

%2.5

.(1975 Rodriguez)

FeSO₄

Zn 22 .5

(1966) Travis Nossaman

ZnSO₄

1-

ZnSO₄ % (0.9 0.6 0.3)
 .(1982 Salem)
 (1997) Rashid
 ZnSO₄ 1- . Zn (27 9 3 1 0)
 %177
 1- .ZnSO₄.7H₂O (1 0.5 0)
 1- . 400
 %76.2 %64.4 (1 0.5)
 . (1999)
 (2001)
 0.1 0.05 0) ZnSO₄ % (0.15 0.1 0.05 0)
 % 0.1 FeSO₄ % (0.15
 %0.15
 AL-Mustafa) 1- .Fe (20 10)
 (2002) .(2001
 1- .Fe (200 150 100 50 0)
 1- .Fe 100
 1- .Fe 100
 (2003)
 %0.4
 / 2004
 (16)
 (1) (30-0)
 (50)
 (RCBD) (20)
 (12) 2 2 (3×3)
 %50 . 1

96 (N % 46) ¹⁻ .N 160
¹⁻ . K 66.4 (P % 20) ¹⁻ . P
(K % 41.5)

45

(Zn%35) ¹⁻ . ZnSO₄.H₂O (2 1, 0)

(Fe20%) ¹⁻ .FeSO₄.7H₂O (2 , 1 , 0.5 , 0)

)
(¹⁻ .³ 0.15) (2001)

% 50

Liang) (1973

$$LA = L \times W \times 0.75$$

W () L (²) LA
0.75 ()

(1)

القيمة	الوحدة	الصفة	القيمة	الوحدة	الصفة
1.03	mg.Kg ⁻¹	DTPA المستخلص بـ Zn	7.9	—	pH
3.42	mg.Kg ⁻¹	DTPA المستخلص بـ Fe	0.8	dS.m ⁻¹	ECe
22.48	Cmol.Kg ⁻¹	CEC	14.7	mmole.L ⁻¹	Ca ⁺⁺
213.50	gm.Kg ⁻¹	Lime	13.3	mmole.L ⁻¹	Mg ⁺⁺
3.72	gm.Kg ⁻¹	الجبس	56.5	mmole.L ⁻¹	Na ⁺
6.28	gm.Kg ⁻¹	O.M	3.80	mmole.L ⁻¹	HCO ₃ ⁻
1.35	Mg.m ⁻³	الكثافة الظاهرية	26.0	mmole.L ⁻¹	SO ₄ ⁼
Clay	طينية	النسجة	66.0	mmole.L ⁻¹	Cl ⁻
165.70	gm.kg ⁻¹	رمل	8.26	gm.kg ⁻¹	N الكلي
102.20		غرين	8.3	mg.Kg ⁻¹	P الجاهز
732.10		طين	142.37	mg.Kg ⁻¹	K الجاهز

48 □ 65

(1990) %15 (¹⁻)

. %15 () 300

.(1976 Ramsay)

-1

-1-1

(2)

159.0

¹⁻ ZnSO₄.H₂O 1

()

Tryptophane

. 145.0

(2)

(IAA)

¹⁻ FeSO₄.7H₂O 1

"

159.0

. 144.0

()

FeSO₄.7H₂O 2¹⁻ ZnSO₄.H₂O 2

Gheith) (1983

Salem)

.(1989

¹⁻ . 1

170

.()

(2)

مستويات الحديد (غم FeSO ₄ .7H ₂ O لتر ⁻¹)					مستويات الزنك
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	(غم ZnSO ₄ .H ₂ O لتر ⁻¹)
145.0	143.0	153.0	149.0	135.0	Zn ₀
159.0	149.0	170.0	163.0	153.0	Zn ₁
148.0	144.0	154.0	149.0	144.0	Zn ₂
	145.0	159.0	153.0	144.0	Mean
LSD _{Zn} =1.5		LSD _{Fe} =1.8			اقل فرق معنوي (0.05)
					LSD _{Zn*Fe} =3.1

-2-1

1

"

(3)

27.16

FeSO₄.7H₂O 1¹⁻ ZnSO₄.H₂O

)

¹⁻ 27.87 ¹⁻¹⁻ 20.42 ¹⁻ 20.49

(

(El- Hariri) (1988) (1988)
 2 FeSO₄.7H₂O¹⁻ ()
 1⁻ 1 1⁻ 2 32.66
 14.74

(f^2) (3)

مستويات الحديد (غم FeSO ₄ .7H ₂ O لتر ⁻¹)					مستويات الزنك (غم ZnSO ₄ .H ₂ O لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	
20.49	19.69	23.91	23.61	14.74	Zn ₀
27.16	22.38	32.66	29.20	24.40	Zn ₁
23.34	21.92	27.04	22.28	22.13	Zn ₂
	21.33	27.87	25.03	20.42	Mean
LSD _{Zn} =1.30		LSD _{Fe} =1.50		اقل فرق معنوي (0.05)	
		LSD _{Zn*Fe} =2.61			

-2-2

(4)

1
 1⁻ FeSO₄.7H₂O 1 1⁻ ZnSO₄.H₂O
 1⁻ 11.74 1⁻ 11.45

(3)

) (1981 Rose)

(1997 Rashid) (2002)

Fe² Zn¹ 1⁻ 12.53
 1⁻ 6.46 ()

(f^2) (4)

مستويات الحديد (غم FeSO ₄ .7H ₂ O لتر ⁻¹)					مستويات الزنك (غم ZnSO ₄ .H ₂ O لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	
8.80	7.68	10.83	10.24	6.46	Zn ₀
11.45	9.83	12.53	12.02	11.40	Zn ₁
9.36	7.36	11.85	9.49	8.73	Zn ₂
	8.29	11.74	10.58	8.87	Mean
LSD _{Zn} =0.21		LSD _{Fe} =0.24		اقل فرق معنوي (0.05)	
		LSD _{Zn*Fe} =0.42			

-2

-1-2

(5)

 $1^{-1} \cdot \text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 1

1

 $1^{-1} \cdot \text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 2 $1^{-1} \cdot \text{ZnSO}_4 \cdot \text{H}_2\text{O}$ $1^{-1} \cdot \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 1 $1^{-1} \cdot \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 2 $1^{-1} \cdot \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 1 $1^{-1} \cdot \text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 1

Pennington Matocha)

(1982) (2002)

(5)

مستويات الحديد (غم $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ لتر ⁻¹)					مستويات الزنك (غم $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	Zn ₀
1774	1687	2074	2041	1295	Zn ₀
2131	1954	2251	2212	2108	Zn ₁
1902	1723	2174	1897	1815	Zn ₂
	1788	2166	2050	1739	Mean
LSD _{Zn} =39		LSD _{Fe} =46		LSD _{Zn*Fe} =79	
اقل فرق معنوي (0.05)					

-2-2 () 300

300

(6)

300

 $1^{-1} \cdot \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 1 $1^{-1} \cdot \text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 1

)

%34.03

8.27

%35.15

8.19

(

(1989) Gheith)

9.03

300

(1997)

.Fe₂ Zn₁

. () 300

(6)

مستويات الحديد (غم $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ لتر ⁻¹)					مستويات الزنك (غم $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ لتر ⁻¹)
Mean	Fe_3	Fe_2	Fe_1	Fe_0	
6.06	5.42	7.43	7.19	4.19	Zn_0
8.19	7.05	9.03	8.44	7.95	Zn_1
6.87	6.19	8.09	6.82	6.38	Zn_2
	6.22	8.27	7.48	6.17	Mean
LSD $_{\text{Zn}}$ =0.19		LSD $_{\text{Fe}}$ =0.22		LSD $_{\text{Zn*Fe}}$ =0.38 (0.05)	

(1-) -3-2

. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 1 1- . $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 1 (7)

5.37 %53.81 1- . 5.31 1-

%53 1- .

6.77 1- . 1 1- . 1

() 1- .

%225 1- . 2.08

Sakal) .(6) (5) (300)

.(2001) (1997 Rashid) (1985

.(1-)

(7)

مستويات الحديد (غم $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ لتر ⁻¹)					مستويات الزنك (غم $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ لتر ⁻¹)
Mean	Fe_3	Fe_2	Fe_1	Fe_0	
3.48	3.46	4.29	4.07	2.08	Zn_0
5.31	4.00	6.77	5.70	4.77	Zn_1
4.04	3.59	5.05	3.83	3.76	Zn_2
	3.68	5.37	4.50	3.51	Mean
LSD $_{\text{Zn}}$ = 0.22		LSD $_{\text{Fe}}$ = 0.26		LSD $_{\text{Zn*Fe}}$ =0.45 (0.05)	

-3

-1-3

(8)

1- . 116.16

()

%96.2

1- . $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 2

1- . 59.20

Rashid)

(2002) (2001) (1997

(8)

2¹⁻ . 92.59
 ()
 %4.6
 1- . FeSO₄.7H₂O
 1- . 88.49

(1966 Travis Nossaman)

.(1- .)

(8)

(1- . FeSO ₄ .7H ₂ O)					(1- . ZnSO ₄ .H ₂ O)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	
59.20	60.12	59.22	58.92	58.54	Zn ₀
96.46	97.86	96.95	96.11	94.93	Zn ₁
116.16	119.79	116.85	115.98	112.02	Zn ₂
	92.59	91.01	90.34	88.49	Mean
LSD _{Zn} = 2.39		LSD _{Fe} = 2.76		LSD _{Zn*Fe} = 4.7	(0.05)

2¹⁻ . ZnSO₄.H₂O 2 (8)
 1- . 119.79
 1- . 58.54 ()
 1- . FeSO₄.7H₂O
 (2002) (1966 Travis Nossaman)

-2-3

(9)

. ZnSO₄.H₂O 2 1- . 141.12
 62.54 ()
 %125.9
 (2005) (2001) (1997 Rashid)
 (9)

1- . FeSO₄.7H₂O 2 1- . 103.12
 1- . 97.45 ()
 %5.8

. (1- .)

(9)

مستويات الحديد (غم $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ / لتر ⁻¹)					مستويات الزنك (غم $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ / لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	
62.45	64.03	62.89	62.54	60.35	Zn ₀
99.56	100.21	100.05	99.87	98.09	Zn ₁
141.12	145.13	143.04	142.39	133.92	Zn ₂
	103.12	101.99	101.60	97.45	Mean
LSD _{Zn} =1.63		LSD _{Fe} =1.89		LSD _{Zn*Fe} = (0.05)	
3.27					

-3-3

LSD

1- . 70.85
2 1- . 56.20
(10) 1- . $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$

1- . $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 1

. (2002) (1977 Jones Brown)

(10)

Matocha)

(2002) (1982 Pennington

. (1- .)

(10)

مستويات الحديد (غم $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ / لتر ⁻¹)					مستويات الزنك (غم $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ / لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	
70.85	82.99	79.73	76.32	44.37	Zn ₀
65.02	75.82	70.11	69.97	44.19	Zn ₁
56.20	66.32	60.39	56.42	41.67	Zn ₂
	75.04	70.08	67.57	43.41	Mean
LSD _{Zn} =0.844		LSD _{Fe} =0.974		LSD _{Zn*Fe} =1.688 (0.05)	

()

82.88 1- . $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ 2) 1- . $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$ 2 1- .

. 1- . 41.67 (

(1964 Ulrich Rosell)

. 1- . 90- 900

-4-3

(11)

Brown)

=

)

.(1977 Jones

.(2002

(2001) (1989 Gheith)

¹⁻ . FeSO₄.7H₂O 2

()

¹⁻ . ZnSO₄.H₂O 2¹⁻ . 112.51¹⁻ . 46.93

()

(2002)

.(¹ .)

(11)

مستويات الحديد (غم FeSO ₄ .7H ₂ O لتر ⁻¹)					مستويات الزنك (غم ZnSO ₄ .H ₂ O لتر ⁻¹)
Mean	Fe ₃	Fe ₂	Fe ₁	Fe ₀	Zn ₀
84.74	112.51	95.67	81.33	48.39	Zn ₀
79.41	97.51	92.01	80.01	48.1	Zn ₁
73.83	89.43	80.05	78.91	46.93	Zn ₂
	99.82	89.24	80.08	47.81	Mean
LSD _{Zn} =1.46		LSD _{Fe} = 1.69		(0.05)	
LSD _{Zn*Fe} =2.93					

¹⁻ . FeSO₄.7H₂O 1¹⁻ . ZnSO₄.H₂O 1

. 2001.

-1

.138-122:1 .1 .

. 2002 .

-2

.94-87:5 33 .

- .2002 . -3
- .86-79 :5 33
 . 2001. -4
 .(Zea mays)
 .1990. -5
- .2002 . -6
- . 109-103: 1 2
 . 1999. -7
 95
 .12-1 :1 36
 .1997 . -8
 : 2 7
 .224-215
 .1990 . -9
 .1989 . -10
- .2003 . -11
 .7-1 :2 8
 .1990. -12
- .1988 . -13
- .2005. -14
- 15- AL-Mustafa,W.A.,A.E.Abdallah,and A.M.Falatah 2001.Assessment of five extractants for their ability to predict iron uptake and response of sorghum grown in calcareous soils.Commun.Soil Sci.Plant Anal. 32:907-919.(Abstract).
- 16- Clark,R.B 1982.Mineral nutritional factors reducing, sorghum yield: Micronutrients and acidity. international crops research institute for the semi-arid tropics.India:ICRISAT.81.179-190.
- 17- EL-Hariri,D.M.,M.O.Kabesh,T.G.Behairy,and T.A.Nour 1988.Growth and yield responses of sesame to foliar nutrition with some micronutrients. Egypt.J. Agron. vol. 13(1-2):115-124.

- 18- Gheith, E.S., A.A. Abdel-Hafith, N.A. Khalil and A. Abdel-Shaheed 1989. Effect of nitrogen and some micronutrients on wheat. *Annals of Agric. Sci. Moshtohor* 20(5):255-268.
- 19- Liang, G.H., C.C. Chu, N.S. Reddy, S.S. Lin, and A.D. Dayton 1973. Leaf blade areas of grain sorghum varieties and hybrids. *Agron. J.* 65:456-459.
- 20- Matocha, J.E. and D. Pennington 1982. Effect of plant iron recycling on iron chlorosis of grain sorghum grown on calcareous soils. *Journal of plant nutrition* 5(4-7):869-882.
- 21- Nossaman, N.L., and D.O. Travis 1966. Grain sorghum production calcareous cut site as influenced by phosphorus, zinc and iron fertilization. *agronomy Journal*. vol. 58, sept-oct:479-480.
- 22- Rashid, A. and K.L. Fox. 1992. Evaluating internal zinc requirements of grain crops by seed analysis. *Agronomy Journal*, Vol. 84:469-474.
- 23- Rashid, A., E. Rafique, N. Bughio, and M. Yasin 1997. Micronutrient deficiencies in rainfed calcareous soils of Pakistan. IV. Zinc nutrition of sorghum. *commun. Soil Sci. Plant Anal.* 28(6-8):455-467.
- 24- Randhawa, N.S. P.N, Takkar, and C.S. Venkata Ram 1974. Zinc deficiency in Indian soils. pages 1-8 in *zinc in crop nutrition*. New York USA: International lead zinc research organization and zinc institute.
- 25- Ramsay G. Cameron. 1976. Spectrophotometric determination of elements
- 26- Rose, I. A. Felton, Wli and L.W. Banks 1981. Response of four soybean varieties to foliar zinc fertilizer. *Aust. J. Exp. Agric. Husb.* 21:236-240.
- 27- Rodriguez, H. Glez 1975. Control of iron deficiency in sorghum. recommendation for EL-Bajio. circular CIAB-centro de investigaciones agricolas del Bajio (Mexico). no 30-2.
- 28- Salem, M.S., A. Roshdy and M.S. Baza 1982. Effect of nitrogen and zinc fertilization on yield and yield components of maize. *Annals of Agric. Sci. Moshtohor*. 18:47-62.
- 29- Salem, M.S., A. Roshdy and M.S. Baza 1983. Effect of nitrogen and zinc fertilization on some growth characters of maize. *Annals of Agric. Sci. Moshtohor*, vol. 20:67-80.
- 30- Sakal, R.B. Sinha. B.P, Singh and A.P, Singh 1985. Use of ferrous sulphate for sorghum and black gram in calcareous soil. *Indian farming*. 26-27.
- 31- Tandon, L.S 1993. *Methods of analysis of soils, plants, waters and fertilizers*. India. New Delhi.