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## IMPORTANCE DE L'APPORT DU FER POUR LA PRODUCTIVITE, LA QUALITE ET LE STATUT NUTRITIF DES AGRUMES

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# CONTEXTE



**Observations  
introductives sur la  
chlorose ferrique**



# CONTEXTE



**Phénomène présent  
sur les jeunes et  
arbres adultes**



# CONTEXTE



On estime que 20 - 50 % des plantations arboricoles souffrent de la chlorose ferrique dans le bassin méditerranéen (*Jaeger et al. 1999*)

La chlorose ferrique affecte le rendement, le calibre et la qualité interne de fruits (*Pestana et al. 2002*)

# CONTEXTE

## Contexte de l'étude

Contexte de prix de vente très bas et coût de production élevé.

Charges de fertilisation ferrique sont lourdes (Fe-Chélaté)

## Objectifs de l'étude

Evaluation de l'intérêt des apports de la fertilisation ferrique.

Optimisation d'apports en cas de nécessité

## Méthodologie du travail

Plusieurs expérimentations ont été conduites sur différentes régions agrumicoles au Maroc (Haouz, Souss, Gharb et Berkane)



# METHODOLOGIE

Soil properties	Gharb
Clay (%)	42.9
Silt (%)	38.1
Sand (%)	19.0
pH <sup>a)</sup>	8.4
Electrical conductivity (ms cm <sup>-1</sup> )	0.34
Total carbonate (%)	28.3
Free carbonate (%)	10.9
Organic matter (%)	2.02
Phosphorus (P) (mg kg <sup>-1</sup> )	113.2
Potassium (K) (mg kg <sup>-1</sup> )	678.4
Magnesium (Mg) (mg kg <sup>-1</sup> )	1048.0
Calcium (Ca) (mg kg <sup>-1</sup> )	6593.0
Zinc (Zn) (mg kg <sup>-1</sup> ) DTPA - extraction	2.59
Iron (Fe) (mg kg <sup>-1</sup> ) DTPA - extraction	18.60
Manganese (Mn) (mg kg <sup>-1</sup> ) DTPA - extraction	6.20

7 années d'expérimentation depuis la plantation (Gharb)



2 combinaisons (Variété/Porte-greffe)

- Washington sanguine / C. Carrizo
- Navel New Hall / C. Carrizo

# METHODOLOGIE

Traitements de Fe – EDDHA 6% (g/arbre)

0 (Témoin)

5

10

15

20

30



Fe – EDDHA contient 6% avec ortho-ortho (4,6%)

**Période d'apport** : 50 % en avril et 50 % en mai.

**Complete randomized blocs : 5 replicates**

**5 trees per experimental unit**

# RESULTATS DE L'ETUDE

Tree foliage volume and trunk circumference of the Newhall navel and Washington sanguine varieties at seven years old

Fe-EDDHA (6%) supply (g/tree)	0 (control)	5	10	15	20	30
	Newhall navel					
Tree foliage volume (m <sup>3</sup> )	25.3±1.0a	25.0±1.1a	28.2±1.2a	24.8±1.1a	24.3±0.9a	24.0±1.5a
Trunk circumference (m)	0.52±0.0a	0.51±0.0a	0.52±0.0a	0.51±0.0a	0.50±0.0a	0.50±0.0a
Washington sanguine						
Tree foliage volume (m <sup>3</sup> )	31.9±1.5a	28.2±1.1a	29.1±1.4a	28.4±1.5a	30.1±1.3a	28.3±1.7a
Trunk circumference (m)	0.54±0.0a	0.48±0.0a	0.50±0.0a	0.52±0.0a	0.49±0.0a	0.50±0.0a

# RESULTATS DE L'ETUDE

Chlorophyll content index of leaves at harvest of the Newhall navel and Washington sanguine varieties from three to seven years old according to soil Fe-EDDHA application

Tree age (years)	3	4	5	6	7
Fe-EDDHA (6%) supply (g/tree)	Newhall navel				
0	96.8±2.4a	159.8±2.6a	149.2±3.1a	161.3±2.9 a	162.9±2.4 a
5	87.9±2.4a	160.9±2.6a	162.8±2.6a	169.5±2.7 a	158.6±2.6 a
10	96.23±2.7a	164.3±2.4a	151.6±2.6a	165.5±3.2 a	166.4±2.3 a
15	89.1±2.4a	157.3±2.7a	147.3±2.7a	168.7±3.1 a	167.6±2.0 a
20	85.1±2.3a	168.7±2.7a	157.5±2.7a	173.7±2.7 a	160.7±2.4 a
30	88.2±2.8a	159.5±2.6a	149.8±2.7a	178.1±2.5 a	165.5±2.1 a
	Washington sanguine				
0	121.3±2.6a	151.4±2.6a	135.5±2.6a	146.2±2.5a	112.3±2.1a
5	123.2±2.9a	165.1±2.7a	146.5±2.8a	144.2±2.8a	124.4±2.6a
10	129.2±3.1a	162.1±2.1a	142.3±2.5a	144.1±2.9a	125.9±2.3a
15	127.2±2.8a	149.0±2.7a	148.8±2.6a	144.5±2.3a	121.3±2.3a
20	132.1±2.8a	155.1±2.3a	140.1±2.5a	154.0±2.6a	122.2±2.5a
30	132.4±2.7a	159.7±2.5a	146.0±2.3a	151.5±2.8a	123.0±2.6a

# RESULTATS DE L'ETUDE

Fruit yield (t ha<sup>-1</sup>) of the Newhall navel and Washington sanguine varieties according to soil Fe-EDDHA supply and tree age

Fe-EDDHA (6%) supply (g/tree)	0 (control)	5	10	15	20	30
Newhall navel						
Tree age (years)						
1	*	*	*	*	*	*
2	3.4±0.3a	3.3±0.3a	2.6±0.4a	3.6±0.3a	2.7±0.3a	3.2±0.3a
3	7.7±0.7a	7.3±0.9a	6.7±0.8a	7.2±0.7a	5.6±0.7a	6.2±0.8a
4	18.2±1.4a	16.8±1.3a	15.8±1.2a	18.7±1.2a	16.6±1.1a	16.5±1.3a
5	47.0±2.7a	47.0±2.0a	50.6±1.9a	47.7±2.3a	44.5±2.4a	45.8±2.7a
6	25.4±1.4a	24.4±0.9a	26.5±1.3a	28.6±1.7a	26.3±1.4a	29.0±1.9a
7	58.5±2.3a	52.7±2.8a	59.0±1.7a	61.9±2.9a	53.2±2.5a	57.8±2.8a
Washington sanguine						
1	*	*	*	*	*	*
2	1.8±0.4a	0.9±0.2a	1.1±0.2a	1.6±0.3a	1.5±0.5a	1.7±0.4a
3	13.6±1.1a	9.3±1.2a	10.7±1.1a	11.2±1.1a	11.0±1.0a	11.3±0.9a
4	25.6±2.0a	20.7±1.8a	19.4±1.9a	20.7±2.1a	21.0±1.7a	23.0±2.2a
5	47.8±1.6a	43.1±2.5a	39.8±2.3a	43.1±2.8a	39.6±1.7a	42.9±2.5a
6	32.9±2.0a	26.6±2.1a	27.9±2.1a	30.3±1.9a	27.3±1.9a	30.8±2.0a
7	41.3±2.1a	36.9±2.2a	34.9±2.4a	35.5±2.4a	34.4±2.3a	37.2±1.8a

# RESULTATS DE L'ETUDE

Fruit equatorial diameter (mm) at harvest of the Newhall navel and Washington sanguine varieties according to soil Fe-EDDHA application for different seasons

Fe-EDDHA (6%) supply (g/tree)	0 (control)	5	10	15	20	30
Tree age (years)	Newhall navel					
1	*	*	*	*	*	*
2	80.6±0.3a	79.4±0.4a	80.3±0.4a	79.8±0.4a	79.8±0.4a	79.7±0.3a
3	85.8±0.4a	84.5±0.5a	86.0±0.4a	86.0±0.4a	85.0±0.5a	85.6±0.4a
4	83.6±0.4a	83.0±0.5a	83.1±0.5a	83.1±0.4a	83.0±0.4a	83.3±0.4a
5	78.3±0.3a	78.4±0.4a	78.1±0.3a	79.1±0.3a	78.5±0.3a	78.8±0.3a
6	79.9±0.4a	79.1±0.3a	79.5±0.3a	79.0±0.4a	79.0±0.3a	79.6±0.3a
7	78.4±0.3a	78.8±0.4a	78.6±0.3a	77.4±0.3a	78.1±0.3a	78.2±0.4a
Tree age (years)	Washington sanguine					
1	*	*	*	*	*	*
2	75.8±0.4a	74.9±0.4a	75.6±0.4a	74.8±0.4a	75.7±0.5a	75.3±0.4a
3	77.7±0.4a	76.6±0.4a	77.8±0.5a	77.5±0.4a	78.4±0.4a	76.8±0.5a
4	77.7±0.4a	77.7±0.4a	78.0±0.3a	77.6±0.3a	78.7±0.4a	77.4±0.3a
5	72.9±0.4a	72.4±0.4a	72.7±0.4a	72.9±0.4a	73.8±0.4a	72.6±0.4a
6	67.2±0.4a	67.3±0.4a	66.8±0.4a	66.4±0.4a	66.5±0.4a	67.6±0.4a
7	68.0±0.4a	67.4±0.4a	68.6±0.4a	68.3±0.4a	68.2±0.4a	68.5±0.3a

# RESULTATS DE L'ETUDE

Iron concentration in leaves (mg kg<sup>-1</sup> of dry matter) for the Newhall navel and Washington sanguine varieties at harvest.

Fe-EDDHA (6%) supply (g/tree)	0 (Control)	5	10	15	20	30
Tree age (years)	Newhall navel					
1	53.6±4.3Ca	50.3±5.3Ca	47.9±4.8Da	55.8±4.7Da	55.5±1.4Da	49.1±1.3Ca
2	127.5±8.7Ba	134.2±12.2Ba	138.3±8.0ABCa	135.8±6.8BCa	123.5±6.3Ca	142.1±11.3Ba
3	129.1±12.1Ba	136.0±6.2Ba	115.7±4.1Ca	132.3±9.8Ca	133.2±10.4BCa	134.9±6.0Ba
4	131.2±4.8Ba	131.1±5.2Ba	123.2±6.4BCa	129.4±3.7Ca	128.4±2.9BCa	134.3±3.9Ba
5	147.0±9.5Aba	141.1±1.8Ba	154.4±14.9Aa	138.6±9.0BCa	128.7±11.9BCa	137.0±3.8Ba
6	159.0±3.6Aa	162.5±4.4Aa	147.4±6.6ABa	161.3±14.5ABa	170.3±12.8Aa	158.2±8.6ABa
7	162.5±3.4Aa	167.1±9.9Aa	159.6±8.4Aa	167.8±5.7Aa	158.6±9.5ABa	169.3±11.8Aa
	Washington sanguine					
1	88.1±4.1Ea	100.1±8.8Ba	83.5±6.1Ea	80.0±5.3Ca	80.5±3.1Da	81.2±3.9Ca
2	138.7±7.1Ca	134.2±4.5Ba	132.8±5.0Ba	137.5±3.8Ba	129.4±1.6Ca	144.3±1.6ABa
3	114.6±7.9Da	102.4±8.0Ba	102.5±8.4Ca	101.9±5.6Ca	105.5±9.1Ca	100.8±5.0BCa
4	150.3±2.2BCa	134.8±10.2Ba	137.4±8.6Ba	142.6±8.0Ba	159.7±5.0Ba	137.0±12.1ABa
5	191.2±14.9Aa	182.9±16.4Aa	183.4±9.1Aa	203.4±15.1Aa	197.7±18.3Aa	196.9±22.0Aa
6	167.5±5.3Ba	170.2±12.2Aa	182.5±3.5Aa	160.7±12.1Ba	177.1±5.7ABa	162.4±5.5Aa
7	148.6±3.2BCa	179.6±7.6Aa	164.4±7.3Aa	163.4±5.3Ba	155.5±6.7Ba	189.6±31.3Aa

# Juice content, total soluble solids, and total acidity of the Newhall navel and Washington sanguine fruits at harvest

		Newhall navel			Washington sanguine		
Tree age (years)	Fe-EDDHA (6%) supply (g/tree)	Juice content (%)	Total soluble solids (°Brix)	Total acidity (g 100ml <sup>-1</sup> )	Juice content (%)	Total soluble solids (°Brix)	Total acidity (g 100ml <sup>-1</sup> )
1		*	*	*	*	*	*
2	0 (control)	36.8±0.9a	10.8±0.2a	0.9±0.1a	33.6±0.8a	11.5±0.3a	0.9±0.0a
	5	36.8±1.4a	10.9±0.3a	0.9±0.0a	35.6±1.1a	12.0±0.0a	0.9±0.1a
	10	35.5±1.6a	10.4±0.1a	0.9±0.1a	33.5±1.6a	11.9±0.2a	1.0±0.1a
	15	34.5±0.8a	10.3±0.3a	0.9±0.0a	33.1±0.7a	11.5±0.2a	0.9±0.1a
	20	36.0±2.2a	10.8±0.3a	0.8±0.1a	32.7±1.2a	11.8±0.3a	0.9±0.1a
	30	36.5±1.9a	10.6±0.2a	0.9±0.0a	35.1±0.8a	11.6±0.3a	0.9±0.1a
3	0 (control)	36.8±1.4a	10.6±0.1a	0.7±0.0a	41.8±0.9a	10.8±0.3a	0.9±0.0a
	5	38.4±0.8a	10.8±0.2a	0.7±0.0a	40.3±1.2a	11.3±0.2a	0.9±0.0a
	10	36.7±1.9a	10.8±0.2a	0.7±0.0a	38.7±0.9a	10.9±0.4a	0.9±0.1a
	15	36.7±1.1a	10.5±0.0a	0.7±0.0a	40.5±1.3a	10.6±0.4a	0.9±0.0a
	20	37.2±1.5a	10.6±0.1a	0.7±0.0a	41.4±2.1a	11.6±0.3a	0.9±0.1a
	30	36.7±0.7a	10.6±0.2a	0.7±0.0a	41.1±1.5a	11.1±0.1a	0.9±0.1a
4	0 (control)	41.1±4.0a	9.2±0.2a	0.8±0.1a	42.5±2.0a	10.6±0.3a	1.0±0.0a
	5	34.6±3.5a	9.0±0.2a	0.8±0.1a	42.1±3.5a	11.3±0.3a	1.0±0.1a
	10	38.7±2.3a	9.4±0.2a	0.8±0.1a	43.5±2.3a	11.0±0.2a	1.0±0.1a
	15	34.0±1.7a	9.2±0.3a	0.8±0.0a	43.6±4.5a	10.7±0.4a	1.1±0.1a
	20	35.3±1.8a	9.2±0.3a	0.8±0.1a	42.3±2.2a	10.9±0.3a	1.0±0.1a
	30	36.8±1.1a	9.2±0.2a	0.8±0.0a	43.0±1.6a	10.9±0.3a	1.0±0.0a
5	0 (control)	43.0±1.3a	12.0±0.2a	0.8±0.0a	47.4±0.8a	12.3±0.2a	1.0±0.1a
	5	43.3±0.5a	12.1±0.4a	0.8±0.1a	49.2±1.0a	12.3±0.3a	1.0±0.1a
	10	43.8±0.7a	11.8±0.3a	0.8±0.1a	47.8±1.1a	12.6±0.2a	1.0±0.1a
	15	43.8±0.8a	11.7±0.4a	0.7±0.1a	46.9±1.1a	12.2±0.2a	1.0±0.0a
	20	45.3±1.3a	11.9±0.5a	0.8±0.1a	46.3±1.7a	12.4±0.5a	0.9±0.1a
	30	43.7±0.6a	11.7±0.3a	0.7±0.1a	47.4±0.8a	12.0±0.3a	1.0±0.1a
6	0 (control)	49.5±0.6a	13.7±0.2a	0.7±0.0a	51.9±0.9a	14.4±0.3a	1.2±0.1a
	5	49.7±1.1a	14.4±0.4a	0.7±0.0a	51.7±0.7a	13.6±0.6a	1.2±0.1a
	10	48.8±0.7a	13.6±0.4a	0.7±0.0a	50.8±1.3a	15.0±0.6a	1.3±0.1a
	15	48.3±1.4a	13.1±0.4a	0.7±0.0a	52.6±1.2a	14.7±0.4a	1.5±0.2a
	20	49.8±0.7a	13.4±0.3a	0.7±0.0a	52.0±1.1a	14.4±0.6a	1.2±0.1a
	30	48.9±0.5a	13.8±0.4a	0.7±0.1a	52.5±0.7a	13.8±0.3a	1.2±0.1a
7	0 (control)	42.7±1.1a	12.5±0.3a	0.5±0.0a	45.4±0.8a	15.4±0.2a	0.6±0.1a
	5	42.1±0.9a	12.4±0.2a	0.5±0.0a	46.1±1.7a	15.5±0.7a	0.6±0.1a
	10	43.2±1.2a	12.7±0.2a	0.5±0.1a	46.0±1.6a	15.7±0.5a	0.6±0.1a
	15	42.0±0.8a	12.1±0.2a	0.5±0.0a	45.1±3.2a	16.1±0.4a	0.6±0.1a
	20	42.5±0.9a	12.5±0.2a	0.5±0.0a	47.4±0.8a	16.2±0.5a	0.7±0.1a
	30	42.1±1.3a	12.8±0.3a	0.5±0.0a	47.0±0.6a	15.2±0.2a	0.6±0.1a

# RESULTATS DE L'ETUDE

Available Fe content in 0-40 cm soil depth (DTPA Extraction) at one and seven years old of the Newhall navel and Washington sanguine varieties.

Fe-EDDHA (6%) supply (g/tree)	0 (control)	5	10	15	20	30
Tree age (years)	Newhall navel					
1	18.6±4.6Aa	19.6±4.2Aa	25.4 ±3.5Aa	19.6±4.2Aa	20.6±3.2Aa	26.4±2.4Aa
7	19.0±3.7Aa	17.1±2.0Aa	17.7±4.4Aa	16.7±1.3Aa	17.1±3.3Aa	20.8±2.3Aa
	Washington sanguine					
1	17.4±0.5a	17.3±1.1a	17.2±1.6a	19.3±2.3a	21.3±4.6a	17.1±1.1a
7	19.3±3.1a	19.7±4.4a	18.6±2.2a	18.6±4.0a	19.7±4.3a	21.1±3.6a

# CONCLUSION

L'apport de Fe n'est pas justifié dans des sols similaires, caractérisées par :

- Teneur en Fe – DTPA supérieure ou égale à 18,6 ppm
- Teneur en calcaire actif inférieure ou égale à 10,9 %

Ceci sera certainement valable sur les porte-greffes moins sensibles à la chlorose ferriques tels que le Macrophylla, le Volkameriana ...

L'apport de Fe ne présente pas d'intérêt économique dans un contexte similaire.

# METHODOLOGIE

5 années d'expérimentation

Soil properties	Value
Clay (%)	35.0
Silt (%)	27.0
Sand (%)	38.0
pH	8,8
Electrical conductivity (ms cm <sup>-1</sup> )	0.23
Total carbonate (%)	4.00
Free carbonate (%)	00
Organic matter (%)	1.86
Available P (mg kg <sup>-1</sup> )	26.89
Available K (mg kg <sup>-1</sup> )	398.40
Soluble Mg (mg kg <sup>-1</sup> )	510.00
Soluble Ca (mg kg <sup>-1</sup> )	4031.95
Zinc (mg kg <sup>-1</sup> ) DTPA - extraction	1.96
Iron (mg kg <sup>-1</sup> ) DTPA - extraction	6.38
Mn (mg kg <sup>-1</sup> ) DTPA - extraction	6.32



**Variétés/ Portes - greffes testés**

- S.aissa / C. Carrizo

# METHODOLOGIE

5 années d'expérimentation

Traitements de Fe – EDDHA 6% (g/arbre)

0 (Témoin)

5

10

15

20

30



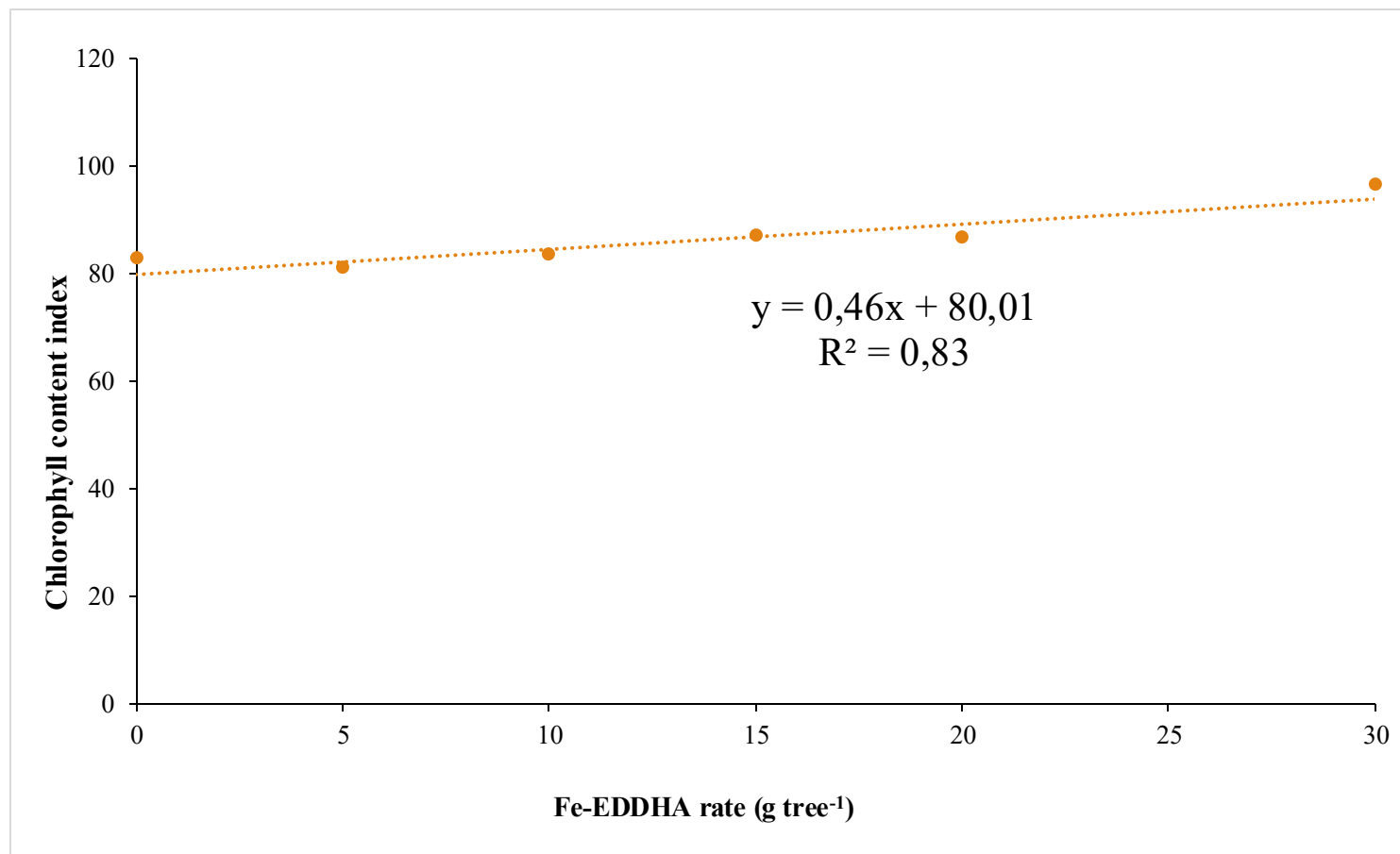
Fe – EDDHA contient 6% avec ortho-ortho (4,6%)

Période d'apport : 50 % en avril et 50 % en mai.

**Complete randomizid blocs : 5 replicates**

# RESULTATS DE L'ETUDE

Average of chlorophyll content index of leaves at harvest of clementine (cv. Sidi Aissa) for 5 experimental seasons.



# RESULTATS DE L'ETUDE

Fruit yield of clementine (cv. Sidi Aissa) according to the soil Fe-EDDHA applications (t ha<sup>-1</sup>) during five production seasons

Fe-EDDHA rate (g tree <sup>-1</sup> )	Fruit yield (t ha <sup>-1</sup> )					
	0 (control)	5	10	15	20	30
Season						
2016	49.2±15.0a	57.9±16.0a	51.4±16.5a	50.6±13.9a	57.4±19.3a	59.0±12.5a
2017	23.0±10.2b	34.1±14.7a	26.6±10.0ab	33.0±12.8a	33.6±12.9a	33.6±12.9a
2018	60.7±17.7a	66.7±19.0a	65.1±14.6a	70.6±15.9a	71.7±22.8a	74.4±23.8a
2019	22.4±7.7c	28.8±6.8ab	25.4±6.2bc	29.2±6.5ab	31.8±6.3a	31.5±7.3a
2020	24.5±5.0c	28.9±6.7b	30.5±8.7b	30.3±6.6b	34.1±8.7ab	36.1±9.4a

$$\text{Fruit yield (t ha}^{-1}\text{)} = 0.30x + 25.80$$

$$R^2 = 0.70$$

# RESULTATS DE L'ETUDE

Fruit equatorial diameter of clementine (cv. Sidi Aissa) according to soil Fe-EDDHA applications

Fe-EDDHA rate (g tree <sup>-1</sup> )	0 (control)	5	10	15	20	30
Season	Fruit equatorial diameter (mm)					
2016	55.4±4.7b	54.9±3.8ab	55.4±3.2ab	55.4±3.6ab	56.3±4.8a	56.0±3.8a
2017	50.7±5.1a	51.2±4.9a	51.3±5.2a	51.0±5.1a	51.1±5.1a	50.6±5.2a
2018	51.0±4.4b	51.6±4.3b	52.8±4.3a	51.1±4.0b	52.8±4.2a	52.8±4.3a
2019	50.1±5.0c	51.2±5.1b	51.8±5.5b	53.1±5.0a	52.9±4.9a	52.9±4.9a
2020	49.2±3.8b	49.2±4.1b	49.5±3.7ab	49.8±4.3ab	49.8±3.9ab	50.2±4.2a

$$\text{Equatorial diameter (mm)} = 0.0443x + 51.04$$

$$R^2 = 0.78$$

# Juice content, total soluble solids (TSS), total acidity (TA) and TSS/TA of clementine (cv. Sidi Aissa).

	Fe-EDDHA rate (g tree <sup>-1</sup> )	Juice content (%)	Total soluble solids (°Brix)	Total acidity (%)	TSS/TA
2016 season	0 (control)	39.8±4.0a	10.3±0.6 a	0.9±0.1 a	10.9±0.8 a
	5	43.7±5.0 a	9.8±0.3 a	1.0±0.0 a	10.0±0.4 a
	10	41.8±3.9 a	10.7±0.4 a	1.0±0.1 a	10.3±1.0 a
	15	41.5±2.6 a	10.7±1.0 a	1.1±0.1 a	10.0±1.2 a
	20	41.5±1.3 a	10.3±0.9 a	1.0±0.2 a	10.3±0.9 a
	30	40.5±3.7 a	10.3±0.9 a	1.0±0.1 a	10.2±0.4 a
2017 season	0 (control)	38.7±5.1 a	12.6±0.6 a	1.3±0.1 a	9.7±0.6a
	5	42.2±2.6 a	11.8±0.6 a	1.3±0.2 a	9.3±0.4 a
	10	42.0±2.9 a	12.2±0.4 a	1.2±0.1 a	10.0±0.6 a
	15	44.1±2.0 a	12.5±0.8 a	1.3±0.1 a	9.9±0.3 a
	20	40.4±4.3 a	11.7±1.3 a	1.2±0.1 a	9.7±0.5 a
	30	44.6±1.8 a	12.2±0.9 a	1.2±0.1 a	9.7±0.5 a
2018 season	0 (control)	43.7±4.3 a	10.7±0.7 a	0.9±0.1 a	11.4±0.6 a
	5	46.3±7.2 a	10.4±0.7 a	1.0±0.1 a	10.8±0.6 a
	10	44.8±4.5 a	10.8±0.6 a	1.0±0.1 a	11.2±1.1 a
	15	48.5±3.5 a	10.9±1.0 a	1.0±0.2 a	11.2±1.1 a
	20	44.7±2.1 a	10.2±1.0 a	0.9±0.2 a	10.9±1.1 a
	30	45.7±3.6 a	10.4±0.6 a	0.9±0.0 a	11.3±0.6 a
2019 season	0 (control)	40.1±2.1 a	10.2±0.5 a	1.0±0.1 a	10.6±0.6 a
	5	42.5±2.7 a	10.6±0.4 a	1.0±0.1 a	11.0±0.6 a
	10	41.0±3.5 a	10.4±0.3 a	1.0±0.0 a	10.4±0.2 a
	15	43.3±1.0 a	10.0±0.6 a	0.9±0.0 a	11.1±0.3 a
	20	40.9±2.3 a	9.9±1.1 a	1.0±0.0 a	10.3±1.1 a
	30	40.4±4.7 a	9.9±0.5 a	1.0±0.1 a	9.9±0.4 a
2020 season	0 (control)	38.2±2.5a	14.2±0.4a	1.4±0.1a	10.0±0.6a
	5	39.4±3.0a	13.2±1.0a	1.3±0.2a	10.6±1.1a
	10	39.6±2.5a	13.3±0.7a	1.3±0.2a	10.4±0.9a
	15	39.5±2.7a	14.1±0.8a	1.4±0.2a	10.1±1.1a
	20	39.2±4.6a	13.1±1.2a	1.2±0.2a	10.7±0.6a
	30	39.5±2.5a	13.1±0.6a	1.2±0.0a	10.9±0.3a

# RESULTATS DE L'ETUDE

Fe content in leaves and fruit of clementine (cv. Sidi Aissa) according to soil Fe-EDDHA applications

Fe-EDDHA rate (g tree <sup>-1</sup> )	0 (control)	5	10	15	20	30
Season	Fe content in leaves (mg kg <sup>-1</sup> )					
2016	192.1±16.6a	178.8±31.1a	206.5±67.3a	182.6±30.4a	173.0±33.8a	192.2±35.2a
2017	176.0±20.7a	159.6±19.2a	186.5±43.5a	176.5±27.8a	177.8±17.9a	166.0±15.9a
2018	178.8±21.0a	158.2±22.4a	168.5±6.0a	163.3±21.2a	156.1±11.2a	169.8±15.4a
2019	123.5±15.9a	112.8±18.6a	110.2±16.8a	119.4±15.8a	107.1±13.9a	111.9±20.0a
2020	153.1±13.1a	152.5±15.8a	143.3±11.9a	145.0±13.3a	150.7±8.0a	142.3±8.7a
Season	Fe content in fruits (mg kg <sup>-1</sup> )					
2016	24.6±8.0a	22.0±2.4a	21.4±2.0a	22.5±1.7a	22.7±5.4a	24.8±3.0a
2017	16.2±1.0a	15.7±2.7a	19.9±6.5a	17.2±5.5a	18.2±4.3a	17.1±2.7a
2018	15.8±3.2a	18.3±4.8a	15.8±2.4a	16.6±3.6a	17.1±4.3a	17.7±4.3a
2019	28.5±3.1a	31.9±6.2a	31.4±4.9a	32.8±5.9a	35.3±6.6a	32.3±2.1a
2020	47.2±2.3a	46.9±1.6a	46.4±1.1a	46.7±1.2a	47.2±1.0a	47.5±1.0a

# RESULTATS DE L'ETUDE

Soil Fe content (DTPA extraction) according to soil Fe-EDDHA applications in clementine orchard (cv. Sidi Aissa) during five experimental seasons

Iron supply (g tree <sup>-1</sup> )	0 (control)	5	10	15	20	30
Season	Soil Fe content (DTPA extraction, mg kg <sup>-1</sup> )					
2016	6.4±1.1a	10.0±1.9a	9.0±1.6a	8.7±1.5a	7.4±2.8a	8.6±0.9a
2018	5.4±0.6a	7.1±2.0a	6.9±1.5a	6.1±2.8a	7.2±1.2a	7.0±2.7a
2020	7.5±1.1a	6.6±1.4a	6.2±0.9a	6.6±1.6a	6.2±1.7a	6.3±1.3a

# CONCLUSION

L'apport de Fe présente un grand intérêt économique notamment pour les années « off » dans le contexte du Haouz caractérisé par :

- Un sol non calcaire mais à pH élevé (8,8)
- Une teneur en Fe – DTPA : **6,38 ppm**
- Un porte greffe connu par sa sensibilité en Fe.
- Les doses recommandées sont au moins **20 g Fe-EDDHA/arbres.**

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Merci

