

## Effect of Foliar Application with Some Micronutrients on Leaf Mineral Content, Yield and Fruit Quality of "Florida Prince and Desert Red" Peach Trees

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**Abstract:** The present investigation was conducted during 2004 and 2005 seasons of 7 years old "Florida Prince and Desert Red" peach trees budded on Nemagrad rootstock grown on sandy soil under drip irrigation system. The trees were sprayed once, twice and thrice a year with combinations of chelate at the rate of 0.7g/L Fe, 0.3 g/L Zn and 0.3 g/L Mn or combinations of Zn, Mn, Fe sulphate at 0.5 g/L. The Trees received one spray (on the 15<sup>th</sup> of February), or two sprays (on the 15<sup>th</sup> of February and the 15<sup>th</sup> of March), or three sprays (on the 15<sup>th</sup> of February, the 15<sup>th</sup> of March and the 15<sup>th</sup> of April). Leaf mineral content, yield and fruit quality were studied. Results indicated that spraying the trees twice or thrice yearly was more effective than spraying once a year and control in improving leaf mineral Zn, Mn and Fe content as well as chlorophyll a, b content of both peach trees. All tested treatments produced a considerable increase in yield, fruit weight, fruit size and fruit firmness of both peach fruits. Moreover they improved most of fruit quality parameters. Generally combination of 0.7g/L Fe+0.3g/L Mn + 0.3g/L Zn chelates treatments was the superior than the other treatments and control of both peach fruits. Meanwhile, spraying the trees twice or thrice a year was more effective than once a year in this respect.

**Key words:** Peach trees, foliar application, micronutrients, fruit quality and yield

### INTRODUCTION

Peach trees are considered one of the important fruit trees in Egypt and the world. The fruit may be consumed fresh or processed into jam or jelly.

Peach tree is known to give intensive growth with somewhat weak wood. In the meantime, peach trees are sulfruitful and set fruits from about 9% of the flowers. Moreover, Peach trees are going to be widespread in the reclaimed areas, which are characterized by some micronutrients deficiency specially Zn, Mn and Fe. Accordingly, application of micro nutrients in the fertilization programs of peach orchards is the ideal solution to correct their deficiency.

Many investigators reported that foliar application of microelements was very effective in improving nutritional status, yield and fruit quality of pears and peach Atawia (1995), Gobara<sup>[9]</sup> and Thomidis *et al.*<sup>[16]</sup>.

Boron as a micronutrient plays an important role in growth behavior and productivity of trees. It increases pollen grains germination and pollen tube elongation, consequents fruit set percentage and finally the yield. Many previous studies revealed that micronutrients foliar sprays enhanced nutritional status and improved the yield and quality of different fruit crops. These studies were supported by Zarrouk *et al.*<sup>[17]</sup> on peach.

The investigation carried out the effect of foliar sprays combination with zinc, manganese and iron sulphate or spraying zinc, manganese and iron chelate up to the three applications yearly on leaf minerals content, yield and fruit quality of "Florida Prince and Desert Red Peach trees".

### MATERIALS AND METHODS

This study was carried out at El-Sadat district, El Menofiya Governorate during the seasons of 2004 and 2005. Healthy and nearly uniform of two peach CVS (Florida Prince and Desert Red) trees of 7 years old budded on Nemagrad rootstock and were grown on sandy soil under drip irrigation system. The trees were grown on sandy soil under drip irrigation system. The trees were planted at 3.5 meters apart. All the plants had received the normal horticultural practices. The trees were sprayed with one of the following solutions.

- Control (sprayed with water)
- Combinations with chelate at the rate of (0.7 / LFe + 0.3 g / LZn)
- Combinations with Zn, Mn and Fe-sulphate at 0.5 g/L.

In this respect, the selected trees were sprayed either once yearly during the 15<sup>th</sup> of February or twice during the 15<sup>th</sup> of February and the 15<sup>th</sup> of March or thrice during the 15<sup>th</sup> of February, the 15<sup>th</sup> of March and the 15<sup>th</sup> of April of both seasons. Anyhow, all treatments were separated from each side with plastic sheets to avoid any combination between them. The other cultural practices were the same for all trees. Each treatment was replicated three times on one tree plot and the randomized complete block design was arranged.

#### Measurements and Determinations:

**1- Leaf Samples:** Samples of twenty leaves from the middle part of the non fruiting shoots were taken randomly from each replicate at the first week of July according to Chuntanaparb and Cummings,<sup>[7]</sup>. The Leaves were cleaned and washed several times with tap water, then washed again by HCL 0.1 N and rinsed by distilled water to remove any spray residues. The leaf samples were air dried, then transferred to a furnace at 70°C until a constant weight and ground in a stainless steel knife mill and digested according to Chapman and Pratt,<sup>[6]</sup>.

- Nitrogen was determined by the Micro Kjeldahl method Jackson,<sup>[11]</sup>.
- Phosphorus was determined by the method by Truog and Meyer,<sup>[15]</sup>.
- Potassium was determined by the Flamephotometer according to the method of Brown and Lilleland<sup>[5]</sup>.
- Iron, Zinc and Manganese spectrophotometer racially using Sp. 1900 Atomic absorption spectrophotometer.
- All events, the determined nutrients were expressed as percentages for N.P. and K and ppm for Zn, Mn and Fe.
- Chlorophyll was determined spectrophotometrically at 660, 640 nm wavelength for chlorophyll (a) and (b), respectively, against the blank methanol, according to method of Beckett *et al.*<sup>[4]</sup>.

**2-Yield and Fruit Quality:** The yield (Kg) and number of fruits per tree was recorded at harvest time (mid of July). Samples consisting of twenty fruits were randomly taken from each replicate for determining; average fruit weight (gm), fruit length (cm), fruit diameter (cm), fruit size (cm), firmness (Kg/cm<sup>2</sup>), total soluble solids % (TSS), Total acidity % (according to A.O.A. C<sup>[1]</sup>) and TSS acid ratio.

Data obtained throughout this study was statistically analyzed using the analysis of variance method as reported by Snedecor and Cochran,<sup>[14]</sup> and the differences between means were differentiated by using Duncan's<sup>[8]</sup> multiple range test.

## RESULTS AND DISCUSSIONS

**1-Leaf Nutrient Contents:** Regarding the effect of spraying trees with some micronutrients on leaf nutrients content (N, P and K ) of "Florida Prince and Desert Red" peach trees during the seasons 2004 and 2005.

Data of table (1) shows that no appreciable difference was noticed among different treatments under study in both seasons regarding leaf N, P and K contents of both "Florida Prince and Desert Red" peach trees.

Data of table (2) revealed obviously that in both seasons foliar application three times/year with (Zn+Mn+Fe) chelates compound or Zn+ Mn+ Fe) sulphate compound achieved the highest values of leaf Zn content of Florida Prince followed by spraying trees twice a year as compared with one spray and the control treatment. Meanwhile, in both seasons, foliar application three times/year with combinations with chelates at the rate of 0.7g/ Fe+ 0.3g/L Zn + 0.3g/L Mn achieved the highest values of leaf Mn content followed by two sprays/year with chelates compound at the rate of 0.7g/L Fe+ 0.3g/L Zn +0.3 g / L Mn the three times / year with combinations of Zn+Mn + Fe sulphate at 0.5 g/L as compared with the other used treatments and the control of both seasons.

Meanwhile, leaf Fe content was superior when trees were sprayed with combinations of chelates at the rate of 0.7g / L Fe + 0.3 g/ L Zn + 0.3 g/L Mn after three times/year as compared with other tested treatments and the control of "Florida Prince and Desert Red" peach trees of both seasons.

In general, no significant difference was obtained between all tested treatments and the control used when N, P and K contents were concerned in both peach trees. Meanwhile, most of the tested treatments tended to increase leaf Zn, Mn and Fe contents over the control. Moreover, spraying the trees twice or thrice a year was more effective than spraying once a year in improving leaf mineral Zn, Mn and Fe contents.

Moreover, spraying both peach trees with chelates compound increased leaf Zn, Mn and Fe content than spraying with sulphate compound and the control. On the contrary leaf N, P and K contents were not affected. These results are in agreement with those obtained by Awad and Atawia<sup>[2]</sup>, Gobara<sup>[9]</sup> and Awad *et al.*<sup>[3]</sup> on Anna apple trees.

They found that spraying the trees twice or thrice a year was more effective than spraying once a year in improving nutritional status of the trees beside correcting Zn, Mn and Fe deficiencies. Meanwhile, Thomidis *et al.*<sup>[16]</sup> on peach they stated that foliar application of a 25% Zinc sulfate solution on the 25<sup>th</sup> of February and 2% Zinc chelate solution on the 20<sup>th</sup> of May

**Table 1:** Effect of foliar application with some micronutrients on leaf nutrients content (N, P and K) of "Florida Prince and Desert Red" Peach trees during 2004 and 2005 seasons.

Nutrients Variety Treatment	N(%)				P(%)				K(%)				
	Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red		
	Season												
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	
Control	2.53	2.61	2.48	2.37	0.21	0.22	0.20	0.21	1.26	1.28	1.24	1.26	
Chelates Compound	One Spray	2.53	2.62	2.49	2.38	0.22	0.22	0.21	0.22	1.26	1.29	1.25	1.27
	Two Sprays	2.54	2.64	2.49	2.40	0.23	0.22	0.21	0.22	1.27	1.29	1.26	1.28
	Three Sprays	2.57	2.62	2.50	2.41	0.24	0.23	0.21	0.23	1.29	1.31	1.27	1.30
Sulphate Compound	One Spray	2.54	2.63	2.48	2.37	0.22	0.22	0.20	0.21	1.27	1.28	1.24	1.26
	Two Sprays	2.55	2.63	2.49	2.39	0.22	0.23	0.21	0.22	1.28	1.29	1.25	1.27
	Three Sprays	2.56	2.63	2.49	2.39	0.23	0.23	0.21	0.22	1.28	1.29	1.25	1.28
L.S Dat 0.05%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

Chelates compound = 0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

**Table 2:** Effect of foliar application with some micronutrients on leaf nutrients content (Zn, Mn and Fe) of "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons.

Nutrients Variety Treatment	Zn(ppm)				Mn(ppm)				Fe(ppm)				
	Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red		
	Season												
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	
Control	14.37	16.25	15.90	16.50	21.10	21.81	20.30	22.50	50.11	48.72	52.10	55.33	
Chelates Compound	One Spray	21.65	20.92	20.69	19.80	34.60	39.11	30.90	38.10	61.24	62.47	60.25	67.40
	Two Sprays	30.10	29.61	30.80	30.10	48.12	52.65	46.52	51.30	69.18	68.18	70.30	76.80
	Three Sprays	39.72	40.10	38.93	41.60	68.50	72.33	64.15	74.70	80.36	82.26	86.12	88.10
Sulphate Compound	One Spray	19.20	21.13	18.46	18.72	27.29	29.18	26.50	25.36	55.64	56.20	55.10	60.20
	Two Sprays	26.37	25.60	25.10	25.10	36.31	39.64	33.90	35.60	61.71	66.50	63.10	71.15
	Three Sprays	30.41	29.10	31.20	31.35	42.80	48.19	45.10	49.50	68.25	71.16	70.45	77.50
L.S Dat 0.05%	2.85	2.28	3.24	1.93	3.68	3.50	3.10	2.72	4.11	3.27	5.22	5.10	

Chelates compound = 0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

increased the Zinc content of leaves and no toxicity was observed, in February did not affect the Zinc content of leaves.

**2-Leaf Chlorophyll Contents:** Table (3) shows that, chlorophyll (a), Chlorophyll (b) and chlorophyll (a & b) were increased with increasing the number of sprays, regardless of treatments in "Florida Prince and Desert Red" peach trees in both seasons of study. Moreover, it is obvious that the three sprays significantly differ than two sprays and one spray in both seasons.

Meanwhile, leaf chlorophyll (a), (b) and (a & b) contents reached the highest value after three times spray of Fe+ Zn +Mn sulphate compound at the rate of

0.5 g/L, then twice spraying of Fe + Zn + Mn sulphate compound at the rate of 0.5 g/L as well as three times sprays of 0.7 g/L Fe+0.3 g/L Mn + 0.3g/L Zn chelates compound respectively of both seasons, while control treatment and one spray gave the lowest value of leaf chlorophyll content of "Florida Prince and Desert Red" peach trees of both seasons. Generally, spraying three times a year of Fe + Zn + Mn sulphate compound at the rate of 0.5g/L treatments were the superior than the other treatments and the control of both "Florida Prince and Desert Red" peach trees.

Meanwhile, spraying the trees twice or thrice a year was more effective than once a year in this respect. These results are in agreement with those

**Table 3:** Effect of foliar applications with some micronutrients on Chlorophylls of "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons.

Measurement	Variety	Chlorophyll a				Chlorophyll b				Chlorophyll a and b			
		Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red	
		Season		Season		Season		Season					
Treatment	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	
Control		25.13	26.45	26.26	25.83	28.65	29.10	28.00	28.10	53.78	55.55	54.26	53.93
Chelates Compound	One Spray	26.50	28.10	27.50	26.36	29.11	30.25	28.91	29.67	55.71	58.35	56.41	56.03
	Two Sprays	28.34	30.26	29.18	27.18	30.11	30.81	31.50	31.60	58.45	61.07	60.68	58.78
	Three Sprays	30.10	32.50	30.36	29.41	32.26	31.60	33.14	33.46	62.36	64.10	63.50	63.05
Sulphate Compound	One Spray	27.26	28.34	27.63	27.92	29.94	31.05	28.95	28.90	57.19	59.39	56.58	56.82
	Two Sprays	29.18	31.84	30.41	30.64	32.14	33.70	32.81	33.29	61.32	65.54	63.22	63.93
	Three Sprays	33.55	35.10	32.15	33.31	35.20	34.15	33.20	33.51	68.70	69.25	65.35	66.82
L.S Dat 0.05%	2.38	2.42	3.02	2.61	2.51	2.19	2.64	2.41	4.16	4.08	4.31	4.21	

Chelates compound = (0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn) chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

**Table 4:** Effect of foliar application with some micronutrients on yield, fruit length and fruit diameter "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons.

Measurement	Variety	Yield (kg) Tree				Fruit length (cm)				Fruit diameter (cm)			
		Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red	
		Season		Season		Season		Season		Season		Season	
Treatment	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	
Control		52.10	49.40	51.25	52.10	4.00	4.00	4.10	4.10	4.05	4.06	4.12	4.12
Chelates Compound	One Spray	53.18	52.91	51.90	53.50	4.10	4.10	4.13	4.11	4.13	4.12	4.15	4.13
	Two Sprays	55.25	54.34	53.65	56.00	4.10	4.12	4.14	4.13	4.12	4.10	4.15	4.14
	Three Sprays	57.60	55.92	55.65	57.60	4.11	4.13	4.14	4.13	4.12	4.15	4.16	4.15
Sulphate Compound	One Spray	53.80	52.10	51.00	53.20	4.00	4.08	4.12	4.10	4.10	4.10	4.12	4.12
	Two Sprays	54.92	53.66	52.00	54.30	4.04	4.10	4.12	4.11	4.10	4.05	4.14	4.14
	Three Sprays	55.00	54.46	53.10	55.60	4.10	4.11	1.13	4.12	4.12	4.13	4.15	4.14
L.S Dat 0.05%	2.91	3.11	3.81	3.09	NS	NS	NS	NS	NS	NS	NS	NS	

Chelates compound = (0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn) chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

obtained by Zarrouk *et al.*<sup>[17]</sup> they found that the leaf chlorophyll concentration at 120 DAFB was positively correlated with Fe floral concentration and with K, Zn and Na leaf concentrations of peach.

**3-Yield and Fruit Quality:** Regarding the effect of micronutrients spray on yield of "Florida Prince and Desert Red" peach trees during seasons 2004 and 2005.

Data in table (4) shows that most of foliar application treatments significantly increased yield/tree compared with the control and one spray except 0.7g/L Fe+0.3g/LZn +0.3/L Mn chelates compound sprays treatment on yield of "Florida Prince" trees during the second season. On the other hand, no appreciable

difference was noticed among different treatments under study in both seasons regarding fruit length and fruit diameter parameters of both "Florida Prince and Desert Red" peach trees.

As regards the effect of foliar sprays of some micronutrients on fruit weight, fruit size and fruit firmness.

It is clear from table (5) that in both seasons, fruit weight and fruit size increased with increasing the number of sprays/year of "Florida Prince and Desert Red" peach trees.

Meanwhile, in the first season the highest value of fruit weight and fruit size were produced after three sprays of 0.7 g/L Fe+0.3 g/L Zn+0.3 g/L Mn chelates

**Table 5:** Effect of foliar application with some micronutrients on fruit weight, fruit size and firmness of "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons.

Measurement Variety	Treatment	Fruit weight (g)				Fruit size (cm)				Fruit firmness (l/inch <sup>2</sup> )			
		Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red	
		Season											
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Control		47.00	45.10	42.80	41.60	52.30	50.90	44.30	48.30	4.05	15.80	16.81	16.90
Chelates Compound	One Spray	50.40	49.30	45.00	45.10	53.60	55.10	48.10	48.30	4.13	16.91	17.30	17.20
	Two Sprays	55.60	54.60	48.30	49.60	57.40	58.60	50.00	51.60	4.12	17.10	17.60	17.50
	Three Sprays	58.30	56.00	55.10	57.20	60.10	59.10	56.30	58.70	4.12	17.51	17.92	17.78
Sulphate Compound	One Spray	49.10	48.80	44.20	43.40	51.90	55.00	47.00	46.20	4.10	16.56	17.10	17.10
	Two Sprays	50.60	53.80	46.10	46.20	53.90	58.10	48.10	48.00	4.10	16.98	17.20	17.20
	Three Sprays	53.20	56.00	49.40	48.90	56.70	59.00	51.40	51.10	4.12	17.11	17.43	17.33
L.S Dat 0.05%		1.93	2.50	5.62	6.71	2.26	2.16	4.08	7.11	NS	0.81	0.87	0.50

Chelates compound = (0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn) chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

**Table 6:** Effect of foliar application with some micronutrients on T.S.S, Acidity and TSS/acid ratio of "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons.

Characteristics Variety	Treatment	TSS %				Acidity%				T.S.S/acid ratio			
		Florida Prince		Desert Red		Florida Prince		Desert Red		Florida Prince		Desert Red	
		Season											
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Control		11.90	12.10	11.70	11.80	0.55	0.52	0.60	0.59	21.64	23.27	19.50	20.00
Chelates Compound	One Spray	12.30	12.60	12.00	12.00	0.57	0.56	0.63	0.63	21.58	22.50	19.05	19.04
	Two Sprays	12.70	12.80	12.50	12.40	0.59	0.60	0.65	0.64	21.52	21.33	19.23	19.34
	Three Sprays	13.20	13.30	12.20	12.90	0.60	0.63	0.66	0.66	22.00	21.11	19.57	19.54
Sulphate compound	One Spray	12.10	12.20	12.00	11.90	0.55	0.55	0.61	0.50	22.00	22.18	19.67	19.83
	Two Sprays	12.60	12.40	12.20	12.10	0.57	0.56	0.64	0.63	22.11	22.14	19.06	19.21
	Three Sprays	13.00	12.70	12.30	12.20	0.68	0.59	0.64	0.64	22.41	21.52	19.22	19.06
L.S Dat 0.05%		0.28	0.86	0.41	0.55	0.02	0.05	0.02	0.03	0.61	0.57	NS	NS

Chelates compound = (0.7 g/L Fe + 0.3g/L Zn + 0.3g/L Mn) chelates      Sulphate compound = Fe + Zn + Mn sulphate at 0.5g/L

of both "Florida Prince and Desert Red" peach trees followed by two sprays of 0.7 g/L Fe + 0.3 g/L Zn+ 0.3 g/L Mn chelates as well as three sprays of Fe+ Zn+ Mn sulphate at the rate of 0.5g/L as compared with the other used treatments and the control. On the other hand, the significant differences among different treatments were nil when fruit firmness was considered of "Florida Prince" peach tree during the first season. Meanwhile, of "Florida Prince" peach tree and both seasons of "Desert Red" tree in the second season. They were no significant differences between the number of applications in the year.

Finally all the tested treatments produced a considerable increase in yield, fruit weight, fruit size and fruit firmness parameters. Generally, combination of 0.7 g/L Fe + 0.3 g/L Zn+ 0.3 g/L Mn chelates treatments were the superior than the other treatments and control when spraying the trees thrice a year. These results are in line with those reported by Awad & Atawia<sup>[2]</sup>, Gobar<sup>[9]</sup> and Awaid *et al.*<sup>[3]</sup> who found that most parameters of yield and fruit quality of apple and pear trees enhanced and improved due to spraying the trees with Zn, Mn and Fe.

Meanwhile Zarrouk *et al.*<sup>[17]</sup> and Thomidis *et al.*<sup>[16]</sup> they found that foliar application of 25% Zinc sulfate solution on the 25<sup>th</sup> of February and 2% Zinc chelate solution on the 20<sup>th</sup> of May increased fruit yield of peach trees.

**4- Chemical Properties:** It is clear from table (6) that both chelates and sulphate compounds treatments gave generally higher percentages of total soluble solids as compared with control of "Florida Prince and Desert Red" peach trees during 2004 and 2005 seasons. However, two and three sprays/year in the first season increased significantly TSS of "Florida Prince and Desert Red" peach trees compared to one spray/year and control. On the other hand, the differences between the number of sprays were not significant in the second season.

Results represented in table (6) show that in the first season spraying trees combinations Fe +Zn+ Mn sulphate at 0.5 g/L three times a year gave the highest value of total acidity of "Florida Prince" peach trees. While, combinations with 0.7 Fe g/L+0.3g/L Zn+0.3g/L Mn chelates gave the highest ones of second season. On the other side, multiple the number of sprays yearly failed to induce any significant effect of total acidity of "Desert Red" peach fruits in both seasons.

TSS/acid ratio significantly affected by treatments since combinations of Fe + Zn + Mn sulphate at 0.5 g/L three times a year recorded the highest value in "Florida Prince" peach fruits during the first season. While, all treatments gave the lowest TSS/acid ratios compared with the control in "Florida Prince" peach fruits during the seasons there were no significant differences between the number of applications in the year and control in "Desert Red" peach fruits.

Finally, from the above mentioned results, it could be concluded that, two or three sprays yearly were more effective in increasing TSS, acidity % and TSS/acid ratio. These results are in agreement with those obtained by Osman<sup>[12]</sup>, Shabeen<sup>[13]</sup> and Hassan<sup>[10]</sup> on olive who reported that TSS%, acidity % and TSS/acid ratio were improved by spraying of micronutrients.

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