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Effect of Different Potassium Fertilizer Sources on Growth and Fruiting of Balady Mandarin Trees

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Abstract

This investigation was carried out at the experimental orchard, Faculty of Agriculture, Assiut University, Egypt, to study the effect of slow release (feldspar), organic (vinasse) fertilizer and biofertilizer (yeast & potassiumage) on growth, nutritional status and fruiting of Balady mandarin trees during 2011, 2012 and 2013 seasons.

Potassium sulphate and potassium thiosulpahte were added at two equal batches on mid of April and July. Yeast, potassiumage and feldspar were applied once on March. Vinasse adding as soil dressing on mid of March and July, whereas, vinasse spraying was applied three times on mid of March, June and August.

The obtained results were summarize as follow:

Using vinasse or feldspar alone or combined with yeast or potassiumage as source of potassium significantly increased the growth and leaf traits compared to fertilize by potassium sulphate (check treatment). Using vinasse spraying or feldspar plus yeast gave the highest growth traits values, whereas potassium thiosulphate spraying 36% and untreated trees recorded the least one.

The maximum C/N ratio of shoots were recorded in shoots of trees that fertilized by feldspar with yeast followed by vinasse and feldspar with potassiumage in descending order.

The maximum yield/tree were recorded on the trees treated with feldspar plus yeast followed by vinasse spraying. Contrarly, spraying potassium thiosulphate 36% and potassium sulphate (check treatment) gave the minimum fruit retention, number of fruit and yield/tree values.

It is evident from the foregoing results that using feldspar alone or plus biofertilizer as well as vinasse improved the growth, nutritional status and fruiting of mandarin trees.

In addition, they are beneficial in the organic farming production. Such method reduces the cost of production as well as environmental pollution problems (chemical fertilizer and industrial wastes).

Keywords: *Bio-fertilization, Feldspar, Potassiumage, Balady mandarin, nutrient status, yield, fruit quality.*

Introduction

Citrus is an important cash crops and an essential source of vitamin C for human diet. It's native tree of tropical and sub-tropical regions. Citrus trees have an outstanding economical importance among fruit crops in Egypt. Mandarin occupies the second planted citrus species after orange. Because of the importance of citrus production in Egypt, it is natural for the citrus growers to be mindful of the factors which may positively influence the productivity such

as bio-fertilization and application of compounds containing K and P nutrients. Potassium plays many important regulatory roles in development of different tissues. It is an essential element in many metabolic processes. Also, it is important macronutrient in nutrition of citrus trees to regular, large-scale production of high fruit quality (Miller *et al*., 1990). Potassium fertilization for citrus trees is essential to produce an economical yield with good fruit quality. All the efficiency of K for citrus trees is associated with the levels, the sources and the number of applications. These factors are responsible to uptake of K by trees. It is very effective especially when applied with the optimum rate of N and P (Fawzi *et al*., 1990 and Dass and Srivastava, 1997). It is generally associated with earliness, increases in yield and fruit size, and production of attractive fruits with good color, good juice color and a high TSS/acid ratio**.** Bio-fertilizers are able to fix atmospheric nitrogen, solubilize P & K and mobilize P, Zn, Fe, Mo to varying extent. They play a significant role in improving soil fertility help host plants to resist diseases and with stand stress conditions. Bio-fertilizers could improve crop productivity through increasing biological N-fixation, availability and uptake of nutrients as well as stimulation of natural hormones (Kannaiyan, 2002; Hegab *et al*., 2005 and El-Salhy *et al*., 2006).

However, the growth, yield and fruit quality of citrus trees were greatly varied according to K sources (Qin *et al*., 1996; Ahmed-El-Saida, 1996 and Hegab 2003). The levels of K (Abdel-Latief, 2002 and Kouka *et al*., 2002) and the number of potassium application (Dass and Srivastava, 1997; Farahat, 2000; Mostafa *et al*., 2005 and Mostafa and Saleh (2006)).

So, the present study aimed to investigate the response of Balady mandarin trees to using fast and slow K fertilizers as well as biofertilizers.

Materials and Methods

The present study was carried out during three successive seasons of 2011, 2012 and 2013 on 17 years old Balady mandarin trees budded on sour orange root stock and planted at 5x5 m apart. They grown at the Experimental Orchard of the Faculty of Agriculture, Assiut University, Egypt, where the soil has a clay texture (Table 1) and irrigated via surface irrigation and it is well drained.

Table 1. Analysis of the soil of the experimental site before starting the study.

Characters		**Character**	
Sand (%)	21.15	Total N (%)	0.14
Silt (%)	31.55	Available P (ppm)	8.25
Clay (%)	48.30	Available K (ppm)	332.15
Texture	Clay	DTPA-extractable	
pH (1:2.5)	8.19	Fe (ppm)	22.70
E.C (1:2.5) (dS/m)	2.26	Mn (ppm)	18.31
Organic matter (%)	1.38	Zn (ppm)	4.6
$CaCO_3$ (%)	3.66		

Twenty four healthy trees with no visual nutrient deficiency symptoms and were as uniform as possible were chosen and assigned for carrying out this experiment. The chosen trees were divided into eight groups. Each group contained (three trees replicates) and received one fertilization regime management as the following.

1. Spraying potassium thisoulphate 36%/tree (120 ml/tree).
2. Spraying vinasse (2% K_2O) 2.5 L/tree.
3. Adding vinasse (2% K_2O) 25 L/tree as soil dressing.
4. Adding feldspar (10% K_2O), 4 kg/tree.
5. Adding feldspar (2 kg/tree) + (100 ml/tree) yeast culture (*Saccharomyces erigans*).
6. Adding feldspar (2 kg/tree) + (200 ml/tree) potassiumage.
7. Adding potassiumage (200 mL/tree) + (500 g/tree) potassium sulphae 48%.
8. Applying the recommended potassium dose (RPD) (1000 g potassium sulphate 48%/tree).

The experiment was setted up in a complete randomized block design (CRBD) with three replicates for per treatment, one tree each. Potassium sulphate and potassium thiosulpahte were added at two equal batches and applied on mid of April and July. Yeast, potassiumage and feldspar were applied once in March and then directly irrigated. Vinasse adding as soil drench twice on mid of March and July, whereas, vinasse spraying was applied three times on mid of March, June and August. Other horticulture practices were carried out as used.

The following parameters were measured during the three growth seasons.

Vegetative growth and nutrient status:

Four main branches which were nearly uniform in growth, diameter and foliage density and distribution around the periphery from each tree were chosen and labeled in February. In the autumn growth cycle, the following vegetative characters were measured:

Shoot length (cm), Leaf number/shoot, Leaf area (cm^2) was estimated by picking and weighing 30 full mature leaves/tree and the weighing of 60 sections of 1 cm^2 (2 sections of 1 cm^2/leaf) were recorded, then the average leaf area (cm^2) = leaves weight (g) x 2/sections weight (g), Leaf chlorophyll content was recorded by using chlorophyll meter (SPAD 502 plus). Using four leaves/replicate from the fourth terminal expended leaf of the shoot.

Nutrient status.

To determine the leaf nutrient content (N, P, K, Fe, Mn and Zn), fifty mature leaves of a seven months age from the non fruiting shoots of the Spring flush were randomly taken from each replicate in mid September. As well as to determine the shoot total carbohydrates and nitrogen, twenty non fruiting shoots with seven months age of the Spring flush were taken at random from each replication. The leaf samples were washed with tap water and distilled water. Then both leaf and shoot samples were air-dried, oven-dried at 70°C to a constant weight, ground in a stainless steel mill and kept for chemical analysis (Nijjar, 1985). One

part of each ground sample was analyzed for total nitrogen by the semi-microkjeldahl technique (Bremner and Mulvaney, 1982 and Wilde *et al*., 1985). Another part of each ground dried leaf sample was wet-digested with concentrated sulfuric acid and 30% hydrogen peroxide according to the method described by Evenhuis and Dewaard (1980). Phosphorus and potassium in the digest were determined by colorimetric and flame photometry methods respectively (Jackson, 1958). Iron, Zn, Mn and Cu in the digests were estimated by using a shimadza model AA 63002 atomic absorption/flame emission spectrophotometer. Other part of each ground shoot sample used to determine the total carbohydrates according to Smith *et al*. (1956).

Yield and its components:

Ten distributed fruiting shoots around trees were chosen and labeled before the beginning of treatments. The flowers per each shoot were recorded. Before harvest, the fruit retention for each branch was calculated as:

$$\text{Fruit retention}(\%) = \frac{\text{Total fruits number}}{\text{Total flower numnrt}} \text{ x } 100$$

At harvesting time, during the last week of December, the number of fruit per tree was counted and then, the yield per tree was calculated.

Fruit Quality:

Samples of 10 fruits were randomly taken from each tree to estimate the fruit quality. The fruit weight and the chemical fruit quality such as total soluble solids %, total acidity %, ascorbic acid and sugar contents % were determined according to A.O.A.C. methods (1985). The obtained data were statistically analyzed according to Gomez and Gomez (1984) and Mead *et al*. (1993) the L.S.D. test was used to define the significant of the differences between the various treatment means.

Results

Vegetative growth:

Tables (2) show the effect of mineral, organic and bio-K on vegetative growth of Balady mandarin trees during 2011, 2012 and 2013 seasons. It is obvious from the data that the results took similar trend during the three studies seasons.

Using vinasse or feldspar alone or combined with yeast or potassiumage as source of potassium significantly increased the shoot length and leaf traits compared to fertilize by potassium sulphate (check treatment). Contrarly, either potassium thiosulphate 36% spraying or potassiumage plus 50% potassium sulphate insignificantly increased these growth traits as compared to check treatment.

Using vinasse spraying or feldspar plus yeast gave the highest growth traits values, whereas potassium thiosulphate spraying 36% and untreated trees recorded the least one. Therefore, it could be concluded that using vinasse and feldspar with yeast or potassiumage would achieve a beneficial improvement for the tree growth vigour.

Nutrients status, shoot total carbohydrates and nitrogen percentage and C/N ratio:

Data illustrated in Tables (3, 4 & 5) show that amending the Balady mandarin trees with mineral, organic and bio-K during 2011, 2012 and 2013 seasons. The results indicated that used either feldspar alone or plus yeast or potassiumage, as well as vi-

nasse had significantly increased leaf contents of N, P, K and micronutrients (Fe, Zn, Mn and Cu) as well as shoot total carbohydrates and C/N ratio compared to using fast release K fertilizer (check treatment).

Using feldspar plus yeast gave the highest leaf contents of N, P, K and some micronutrients and C/N ratio values, but the least of these characters were recorded when using potassium thiosulphate 36% spraying and potassium sulphate 48% (check treatments).

The maximum C/N ratio of shoots were recorded in shoots of trees that fertilized by feldspar plus yeast followed by potassiumage plus 50% of potassium sulphate, vinasse and feldspar with potassiumage in descending order. Therefore, it could be concluded that fertilizing by either vinasse or feldspar plus yeast or potassiumage would achieve a beneficial improvement to tree vigour and nutritional status.

Yield and its components:

Data in Table (6) indicated that used feldspar alone or incombined with yeast or potassiumage as well as vinasse significantly increased the fruit retention %, fruits number and yield (kg)/tree compared to fertilize by spraying potassium thiosulphate 36% and potassium sulphate (check treatment).

Table 2. Effect of different Potassium fertilizer sources on shoot length (cm), leaves number/shoot, leaf area (cm^2) and chlorophyll % of Balady mandarin trees during 2011,2012 and 2013 seasons.

Characters / Treat.	Shoot length(cm)			Leaves number/shoot			Leaf area(cm^2)			Chlorophyll %		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	37.67	40.67	50.15	30.33	31.20	38.30	7.50	7.33	10.20	41.00	43.90	52.30
Vinasse Spray	41.83	43.67	53.00	33.65	34.33	40.30	8.20	8.33	13.37	43.80	46.90	55.68
Vinasse Add	41.33	42.67	51.25	33.35	33.67	39.67	8.00	8.24	13.17	42.00	43.88	52.10
4 Feldspar	39.85	42.66	51.50	31.85	32.67	38.33	8.00	8.13	11.50	42.60	46.12	53.80
2 Feldspar+200 Y	40.67	43.33	52.80	32.65	33.80	39.85	7.95	8.52	12.20	47.33	51.27	59.27
Feldspar+200 pot	40.50	42.60	52.00	32.33	33.33	38.10	7.42	7.80	10.37	43.33	48.53	54.23
200 potas+50% K	37.83	41.00	50.00	30.85	30.67	36.30	7.47	7.10	9.50	43.87	45.37	53.20
Control (100% mineral)	35.80	39.00	48.33	28.80	28.67	34.80	7.24	6.95	9.60	40.30	43.22	51.80
LS.D. 5%	2.98	2.86	2.66	2.65	2.88	3.05	0.43	0.38	0.61	1.68	1.60	1.96

Table 3. Effect of different Potassium fertilizer sources on contents of N, P and K% in leaves of Balady mandarin trees during 2011, 2012 and 2013 seasons.

Characters / Treat.	N%			P%			K%		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	2.29	2.11	2.20	0.29	0.29	0.28	1.48	1.56	1.60
Vinasse Spray	2.61	2.43	2.55	0.40	0.41	0.41	1.72	1.79	1.82
Vinasse Add	2.53	2.40	2.51	0.34	0.36	0.35	1.56	1.63	1.62
4 Feldspar	2.18	2.03	2.12	0.31	0.32	0.32	1.68	1.78	1.80
2 Feldspar+200 Y	2.63	2.48	2.57	0.45	0.47	0.46	2.05	2.10	2.11
Feldspar+200 pot	2.34	2.20	2.24	0.32	0.34	0.34	1.74	1.82	1.84
200 potas+50% K	2.18	2.05	2.11	0.27	0.29	0.28	1.64	1.72	1.71
Control (100% mineral)	2.22	2.06	2.16	0.28	0.29	0.28	1.52	1.60	1.58
LS.D. 5%	0.10	0.12	0.08	0.02	0.02	0.03	0.08	0.06	0.06

Table 4. Effect of different Potassium fertilizer sources on contents of Fe, Mn and Zn (ppm) in leaves of Balady mandarin trees during 2011, 2012 and 2014 seasons.

Characters / Treat.	Fe (ppm)			Mn (ppm)			Zn (ppm)		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	132.00	144.70	134.60	31.13	34.32	31.73	36.42	41.10	38.16
Vinasse Spray	130.25	142.03	133.55	31.55	35.18	32.37	31.10	41.11	33.28
Vinasse Add	132.25	145.48	134.86	25.82	27.80	26.26	27.11	35.81	29.75
4 Feldspar	125.75	137.68	128.21	21.52	25.10	22.81	29.42	38.00	23.15
2 Feldspar+200 Y	141.25	154.50	145.65	26.11	30.81	27.11	40.60	44.31	41.58
Feldspar+200 pot	132.50	144.53	135.03	24.71	27.60	25.58	37.58	46.40	39.52
200 potas+50% K	134.25	145.83	136.54	25.76	29.11	28.65	36.18	45.25	38.72
Control (100% mineral)	111.29	119.28	114.90	18.17	21.51	18.48	25.84	32.60	27.22
LS.D. 5%	7.83	8.48	8.02	1.88	2.19	1.87	1.87	2.43	2.03

Table 5. Effect of different Potassium fertilizer sources on shoot total carbohydrates %, total nitrogen% and C/N ratio in shoots of Balady mandarin trees during 2011, 2012 and 2013 seasons

Characters / Treat.	Shoot total carbohydrates %			Shoot total nitrogen %			C/N ratio		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	7.97	7.88	8.39	0.92	0.97	0.96	8.66	8.12	8.74
Vinasse Spray	9.61	9.55	10.05	1.05	1.07	1.06	9.15	8.93	9.48
Vinasse Add	9.47	9.41	9.96	1.03	1.07	1.05	9.19	8.79	9.49
4 Feldspar	8.05	7.98	8.48	0.91	0.95	0.93	8.85	8.40	9.12
2 Feldspar+200 Y	9.82	9.69	10.33	1.05	1.09	1.07	9.35	9.89	9.65
Feldspar+200 pot	8.23	8.42	8.85	0.90	0.95	0.94	9.14	8.86	9.41
200 potas+50% K	8.20	8.25	8.69	0.89	0.93	0.91	9.21	8.87	9.55
Control (100% mineral)	7.33	7.20	7.56	0.91	0.95	0.93	8.05	7.59	8.13
LS.D. 5%	0.33	0.29	0.31	0.03	0.04	0.04	0.32	0.29	0.34

Table 6. Effect of different Potassium fertilizer sources on fruit retention %, fruit number/tree and yield/tree of Balady mandarin trees during 2011, 2012 and 2014 seasons

Characters / Treat.	Fruit retention %			Fruit Number /tree			Yield/tree(kg)		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	1.41	1.70	1.84	226.00	349.60	323.67	32.65	49.54	53.13
Vinasse Spray	1.72	1.94	1.98	278.33	392.00	378.33	41.67	57.33	65.81
Vinasse Add	1.66	1.85	1.92	273.00	394.30	381.60	39.73	56.20	62.50
4 Feldspar	1.56	1.85	1.90	251.80	383.33	368.30	36.80	55.50	61.10
2 Feldspar+200 Y	1.83	2.01	2.04	268.00	403.30	396.67	41.68	61.43	68.54
Feldspar+200 pot	1.68	1.89	1.99	263.33	395.67	382.67	39.11	58.50	65.40
200 potas+50% K	1.65	1.84	1.97	265.00	393.50	384.00	38.83	56.78	63.55
Control (100% mineral)	1.38	1.66	1.80	218.00	340.80	315.30	31.33	47.30	51.20
LS.D. 5%	0.11	0.08	0.10	8.63	12.66	10.73	1.39	1.98	2.20

The maximum yield/tree were recorded on the trees that fertilized by feldspar with yeast followed by vinasse spraying. Contrarly, spraying potassium thiosulphate 36% and potassium sulphate (check treatment) gave the minimum fruit retention, number of fruit and yield/tree values.

It could be concluded that feldspar and biofertilizer and organic (vinasse) were a good modern method to increase the yield. In addition, they are beneficial in the organic farming production since they improved the soil structure and fertility of the soil. Such method reduces the cost of production as well as environmental pollution problems (chemical fertilizer and industrial wastes).

4 – Fruit quality:

It is evident from data in Tables (7 & 8) that using of slow release-K and either bio-fertilization (yeast and potassiumage) or organic-K (vinasse) significantly improved fruit quality in terms of increasing fruit weight, TSS, sugar and vitamin (C) contents and decreasing total acidity compared to fertilizing by the recommended does of potassium (RDK) via fast release mineral source alone.

Using feldspar with yeast as a natural source of potassium gave the maximum values of these fruit traits compared to fertilize by potassium sulphate (check treatment). On the other hand, the least values of physical fruit traits were recorded with check treatment and spraying potassium, thiosulphate 36%.

Therefore, it can be concluded that fertilizing with feldspar and biofertilizer (yeast and potassiumage) and organic-K (vinasse) were significantly improved the fruit properties and hastened the fruit maturation. Such fertilization programs are very important in mandarin fruits production, since the increase in fruit weight and size induce an increase in marketable.

Table 7. Effect of different potassium fertilizer sources on fruit weight, total soluble solids % and acidity % in juice of Balady mandarin fruits during 2011, 2012 and 2013 seasons

Characters / Treat.	Fruit Weight(g)			T.S.S %			Acidity %		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	145.55	142.67	165.30	11.67	12.10	12.58	1.17	1.22	1.29
Vinasse Spray	150.80	147.33	174.40	12.10	12.33	13.00	1.04	1.07	1.10
Vinasse Add	146.00	143.10	164.67	12.50	12.80	13.20	1.02	1.04	1.08
4 Feldspar	147.23	145.33	166.20	11.90	12.20	12.80	1.10	1.12	1.16
2 Feldspar+200 Y	157.00	153.67	173.80	12.00	12.67	13.10	1.01	1.05	1.10
Feldspar+200 pot	150.00	148.60	171.20	11.83	12.25	12.76	1.05	1.07	1.11
200 potas+50% K	147.80	145.33	167.67	11.90	12.20	12.83	1.06	1.08	1.10
Control (100% mineral)	143.43	140.33	162.67	11.50	11.83	12.33	1.22	1.28	1.35
LS.D. 5%	3.08	2.88	3.15	0.30	0.28	0.31	0.06	0.07	0.07

Table 8. Effect of different Potassium fertilizer sources on total sugar %, reducing sugar % and V.C (mg/100g juice) of Balady mandarin juice during 2011,2012 and 2014 seasons

Characters / Treat.	Total sugar %			Reducing sugar %			V.C (mg/g f.w)		
Season	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
K spray	8.00	8.55	9.08	3.02	3.11	3.75	43.25	45.11	46.25
Vinasse Spray	8.47	9.10	9.32	3.17	3.34	3.76	47.50	48.33	48.00
Vinasse Add	8.75	9.26	9.80	3.25	3.41	4.01	48.60	49.67	50.30
4 Feldspar	8.65	9.30	9.83	3.21	3.54	4.08	46.20	47.33	46.50
2 Feldspar+200 Y	8.94	9.48	10.13	3.38	3.65	4.32	54.17	56.30	55.67
Feldspar+200 pot	8.62	9.25	9.83	3.20	3.46	4.11	50.67	53.00	53.18
200 potas+50% K	8.68	9.16	9.82	3.28	3.43	4.10	50.17	52.30	52.80
Control (100% mineral)	7.83	8.56	8.08	2.62	3.04	2.71	42.83	44.67	45.33
LS.D. 5%	0.42	0.37	0.30	0.11	0.13	0.15	1.36	1.28	1.40

Discussion and Conclusion

Potassium is important in the formation and function of proteins, fats, carbohydrates and chlorophyll and in maintaining the balance of salts and water in plant cell (Marschner, 1995). Potassium activates many different enzymes involved in plant growth and vigor improves qualitative aspects of production such as colour, taste, consistency and preservation of many fruits (Dhillon *et al*., 1999).

Feldspar as a natural potassium source contains some other nutrients that suitable for trees and easily gets soil fertility. Using feldspar increased the number and area of leaf which induce an increasing in leaef photosynthesis and accumulation of dry matter of shoots and improving the vigour and nutritional status and fruiting of trees (Abdel-Rahman, 2010).

Vinasse as a sugar cane distillery wastes, has been used as soil amendment, since it contain important amounts of plant nutrients and organic matter. Vinasse contains high levels of organic matter, potassium, calcium and moderate amounts of nitrogen and phosphorus. Application of vinasse is a common practice in sugar cane cultivated areas and can fully substitute K and partially P on crops fertilization (Gomez and Rodriguez, 2000).

The great benefits of biofertilizers on growth and fruiting of Balady mandarin trees were attributed to their positive action on enhancing microflora activity, soil fertility, N fixation and availability of all nutrients (Kannaiyan, 2002). Using potassiumag as a potassium source which improved the growth, yield and fruit quality due to potassium has a main role in lote of physiological processes.

The promotive effect of potassium fertilization on growth, nutrient status and fruiting of citrus trees were emphasized by El-Safty *et al*. (1988), Ibraheim *et al*. (1993), Achulea (1998), Meng (1998), Wei *et al*. (2002), Abd-Allah (2006), Mostafa and Saleh (2006), Hafez-Omaima & Metwally (2007), Abdel-Rahman (2010) and Ali *et al*. (2011). They concluded that using different forms of potassium fertilization had a posi-

tive effect on leaf mineral content, fruit set and yield as well as fruit quality.

Conclusion

In general, it is concluded that using feldspar as natural potassium source incombined yeast or potassiumage, as well as vinasse as organic-K improved the nutritional status and fruiting of mandarin trees.

References

A.O.A.C. Association of Official Agricultural Chemists (1995): Official Methods of Analysis 14th ed. (A.O.A.C.) Benjamin Franklin Station, Washington D.C. U.S.A., pp 490-510.

Abd-Allah, A.S.E. (2006): Effect of spraying some macro and micro nutrients on fruit set, yield and fruit quality of Washington novel orange trees. J. of Appl. Sci. Rese 2 (11): 1059-1063.

Abdel-Latif, M.A. (2002): Studies on potassium fertilization on Balady mandarin trees. M.Sc. Fac. Agric., Minia Univ., Egypt.

Abdel-Rahman, M.M. (2010): Effect of different sources of nitrogen and potassium fertilizers on growth and fruiting of Balady mandarin trees. Ph.D. Thesis, Fac. of Agric., Assiut Univ., pp. 57-169.

Achulea, O. (1998): Citrus and tomato quality is improved by optimized K nutrition. In: Improved crop quality by nutrient management. Amac, D. and P. Martin-Prevel (eds) Kluwere Academic Publishers 19-22.

Ahmed, El-Saida, S. (1996): Physiological studies on nutrition in citrus. Ph.D. Thesis, Fac. Agric., Menofiya Univ.

Ali, O.A.; A.M. El-Salhy; H.A. Abdel-Galil and S.M. El-Masry (2011): Effect of different potassium fertilizer sources and antioxidant application on vegetative growth, nutrient status and fruiting of Balady mandarin trees. Assiut J. Agric. Sci., 42 (special issue): 317-331.

Bremner, J.M. and C.S. Mulvaney (1982): Nitrogen- Total pp. 595-624. In A. L. page, R. H. Miller and D. R. Keeny (eds.) Methods of soil Analysis- part 2. Chemical and Microbiological properties 2nd ed. Am. Soc. Agron. Madison, Wisconsin, U. S. A.

Dass, H.C. and A.K. Srivastava (1997): Role of potassium in citrus nutrition a review. Journal of potassium Research. 13 (1): 80 -92.

Dhillon, W.S.; A.S. Bindra and B.S. Brar (1999): Response of grapes to potassium fertilization in relation to fruit yield, quality and petiole nutrient status. J. of Indian Society of Soil Sci., 47 (1): 89-94.

El-Safty, M.A.; E.A. El-Menshawi and Rabeii (1988): Response of Washington novel orange trees to different doses of potassium sulsphate. A- Yield, fruit quality and mineral composition. J. Agric. Sci. Mansoura Univ., 23: 2611-2618.

El-Salhy, A.M.; H.M. Marzouk and M.M. El-Akkad (2006). Biofertilization and elemental sulphur effects on growth and fruiting of King's Ruby and Roomy grapevines. Egyptian J. of Horti., 33: 29-44.

Evenhuis, B. and P.W. Dewaard (1980): Principles and practices in plant analysis. FAO, soil Bull. 38: 152-163.

Farahat, A.R. (2000): Physiological studies on nutrition of Washington Navel orange trees. Ph.D. Thesis, Fac. Agric., Mansoura Univ.

Fawzi, A.F.A.; M.M. El-Fouly and F.K. El-Baz (1990): Problems of potassium nutrition in citrus (*C. Sinensis*) orchards in Egypt. Dordrecht, Netherlands; Kluwer Academic Publishers., 729-733, Developments in Plant and Soil Sci. Vol. 41.

Gomez, J. and Rodriguez, O. 2000: Effect of vinasse on sugar cane productivity. Rev. Fac. Agron. (Luz) 17: 318-326.

Gomez, K.A. and A.A. Gomez (1984): Statistical Procedures for Agriculture Researches (2nd Ed.) Published by John Wiley and Sons, New York, U.S.A. pp. 10-20.

Hafez-Omaima, M. and I.M. El-Metwally (2007): Efficiency of zinc and potassium sprays alone or in combination with some weed control treatments on weeds growth, yield and fruit quality of Washington novel orange orchards. J. of Appl. Sci. Res., 3 (7): 613-622.

Hegab, M.Y. (2003): Performance of Valencia orange trees to various sources, levels and number of potassium applications. Minia J. of Agric. Res. & Develop. 23 (1): 97-116.

Hegab, M.Y.; A.M.A. Shaarawy and S.A.G. El-Saida (2005): Effect of Algae extract and mono potassium phosphate on growth and fruiting of Balady orange trees. Bull. Fac. Agric. Cairo Univ., 56: 107-120.

Ibraheim, T.A.; F.F. Ahmed and K.G. Assay (1993): Behaviour of Balady mandarin trees (*Citrus reticulata* L.) growing in sandy soil to different forms and concentrations of potassium foliar sprays. Assiut J. Agric. Sci., 24 (3):

Jackson, M.L. (1958): Soil chemical analysis. Prentice-Hall Inc. Englewood Cliffs, New Jersey, U.S.A.

Kannaiyan, S. (2002): Biotechnology of Biofertilizers. Alpha Sci. Inter. Ltd B. O. Bpx 4067 Pang Boorne R. 68 U. K. pp 1-275.

Kouka, H.A.; M.S. Meligi; I.A. Mousa and F.G. Nakhla (2002): Effect of some nitrogen and potassium fertilization rates on yield, fruit quality and vegetative growth of Balady orange trees under conditions of sandy soil on drip irrigation. Minufia J. Agric. Res. 22 (1): 183-202.

Marschner, H. (1995): Mineral nutrition of higher plants. Second Ed. Academic Press-San Diego, CA.

Mead, R.; R.N. Gurnow and A.M. Harted (1993): Statistical Methods in Agriculture and Experimental Biology 2nd Ed. Champan and Hall. London. pp.10- 44.

Meng, A. (1998): Experiment of applying bio potassium fertilizer for Shatianyou Pomella variety. South China fruits. 27 (6): 22-27.

Miller, E.W.; R.L. Donahue and J.U. Miller (1990): Soils "An Introduction to soils and plant Growth" 5th ed. Prenticeo Hall International Inc. Engleword Cliffs, New Jersy, pp 303- 339.

Mostafa, E.A.M. and M.M.S. Saleh (2006): Response of Balady mandarin trees to girdling and potassium sprays under sandy soil con-

ditions. Research J. of Agric. and Biological Sci., 2 (3): 137-141.

Mostafa, E.A.M.; H.S.A. Hassan and A.S. El-Sabag (2005): Influence of spraying GA_3 and KNO_3 on yield, fruit quality and leaf mineral contents of Balady mandarin trees. Minufiya J. Agric. Res., 30 (1): 283-295.

Nijjar, G.S. (1985): Nutrition of fruit tees. Mrs. Usha Raj Kumar for Kalyanin publishers, New Delhi, pp. 10-52.

Qin, X.N.; Y. Velin; T.J. Young and H. Shaogua (1996): The role of potassium in preventing leaf drop and improving fruit yield and quality of lemon (*Citrus limon* Burm). J. of South West Agric. Univ., 18 (1): 20-23.

Smith, F.; M.A. Gilles; J.K. Homilton and P.A. Godes (1956): Colormimetric methods for determination of sugar and related substances Chem. 28: 350- 356.

Wei, L.J.; C. Fang; L. Dongbi; W. Yun Fam; Y. Chang Bing and W.Y. Hua (2002): Potassium chloride on growth of citrus tree, yield and quality of fruits. Soil and Fertilizers Beijing, 4: 34.

Wilde, S.A.; B.B. Gorey; J.G. Layer and J.K. Voigt (1985): Soils and Plant Analysis for tree culture. Published by Mohan primlani, Oxford and IBH publishing Co. New Delhi, pp. 1- 142.

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تأثير استخدام مصادر مختلفة من الأسمدة البوتاسية علي نمو وإثمار أشجار اليوسفي البلدي

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الملخص

أجريت هذه الدراسة خلال ثلاثة مواسم متتالية (٢٠١١ ، ٢٠١٢ و ٢٠١٣) علي أشجار اليوسفي البلدي بمزرعة كلية الزراعة – جامعة أسيوط – مصر . بهدف دراسة تأثير الأسمدة البوتاسية الطبيعية والحيوية علي النمو الخضري والحالة الغذائية للأشجار والمحصول والصفات الثمرية على أشجار اليوسفي البلدي.

ويمكن تلخيص أهم النتائج كما يلي:

- سبب رش الفيناس كمصدر للبوتاسيوم أو استخدام الفلسبار + ٢٠٠ مل خميرة وكذلك الفلسبار + ٢٠٠ مل من البوتاسيوماج زيادة جوهرية في صفات النمو ومساحة الأوراق وكذلك الكلوروفيل مقارنة بالكنترول.
- أدي الرش بالفيناس وإضافة الفلسبار مع السماد الحيوي زيادة مؤكدة في النسبة المئوية للنيتروجين والفسفور والبوتاسيوم وكذلك العناصر الصغري (Fe, Mn, Zn & Cu) ونسبة الكربوهيدرات إلي النيتروجين بالأفرع مقارنة بالكنترول مما أدى الى زيادة جوهرية فى مكونات المحصول وخصائص الثمار مقارنة باستخدام الصورة المعدنية فقط.
- من نتائج هذه الدراسة يتضح أهمية تلقيح التربة بالخميرة أو البوتاسيوماج مع الفلسبار بمعدل ٥٠% للشجرة وكذلك الرش بالفيناس حيث يؤدي ذلك إلي تحسين النمو والحالة الغذائية للأشجار مع زيادة المحصول وخصائص الثمار. كما يؤدي ذلك إلي تقليل معدل التسميد البوتاسى المعدني مما يؤدي إلي تقليل تكاليف الإنتاج وتلوث البيئة.