Effect of Mineral and Bio-fertilization on Growth, Fruit Quality and Mineral Composition Washington Navel Orange Trees

Elkhayat, H.M. and Elashry, H.A.
Horticulture Research Institute, Egypt

Abstract: present study was conducted during the two growing seasons 2010 and 2011 at El Boseli Basateen Farm in order to investigate the effect of mineral fertilizer (NP) and bio fertilizer(Nitrobin and Phosohorin) applied either alone or in combinations to fifteen years old Washington Navel Orange trees on growth , fruit quality and leaf mineral contents . The summarized results were as follows canopy growth increment had a significant increase with all treatments except those with 300 g Nitrobin as compared with control increment. The trees height and trunk diameter increment were significantly greater by all treatments as compared with control increment. 750 ammonium nitrate +200 g Nitrobin treatment increased leaf phosphorous and fruit diameter in the first season fruit weight, juice volume and acidity in both seasons as compared with the control. Also 300g Nitrobin, treatment increased acidity , leaf phosphorous and nitrogen in the first season and fruit diameter in the second season and fruit weight in both seasons as compared with the control .Furthermore ,500 g calcium super phosphate + 100 g Phosphorin treatment increased Leaf phosphorous and juice volume in the first season ,fruit length and Vc in the second season and fruit weight and diameter in both seasons as compared with the control .In addition,250 g calcium super phosphate + 200 g Phosphorin treatment leaf nitrogen and juice volume in the first season and leaf phosphorous and Vc in the second season. Moreover, 300g phosphoreen treatments increased fruit diameter and leaf phosphorous in the first season, juice volume, Leaf potassium and nitrogen in the second season and fruit weight in both seasons as compared with the control. Whereas in the first season leaf nitrogen increased with all treatments as compared with the control.
Keyword: Bio-fertilizer, Washington navel orange trees, Nitrobin - Phosohorin

Introduction

In Egypt the consumption perfect are of chemical fertilizer has reached about ten times more than average consumption of the whole world (FAO, 1994). So we need for minimizing the use of chemical fertilizers such as biofertilzers, which contain primarily potent strains of microorganisms and safe for human , animal and environment . They fix and enhance availability of nutrients nitrogen (Frankenberger and Arshad, 1995). Moreover, they directly or indirectly increase the availability of nutrients in the soil and improve their uptake and utilization (Abd –Elmoniem and Radwan,2003). The microorganism in bio-fertilizer such as Azotobacter produce growth regulators like IAA&GA and hence positively influenced plant growth(Sharma an Kumar,2008). This investigation carried out to study the use of bio fertilizer to improve growth and productivity of Washington Navel Orange trees Orange is a vitamin C – rich fruit and very popular to the Egyptian consumer .The present work was under taken to study the effect of nitrogen and phosphorus bio fertilizer and different rates of nitrogen and phosphorus mineral fertilizer on growth and leaf minerals content ,fruit quality grown in sandy loam soil in (El Bossily Basateen Farm).

Materials and Methods

The present study was carried out during 2010 and 2011 seasons on 15 years Washington Navel Orange on sour orange (*Cit. aurantium, L.*) grown at El Bossily Basateen Agriculture Research Center in sandy loam soil . soil was sandy loam with pH of 7.29 and soil analysis is presented in Table (1). Trees was selected as uniform as possible and received different mineral and bio fertilizer applications, the mineral fertilizers were ammonium nitrate (33.5%N)

and calcium super phosphate (15.5%P_2O_5) . The bio fertilizer were NitrobIn and PhosphorIn ,produced by General Organization for Agriculture Equalization Fund (GOAEF), Ministry of Agriculture , Egypt . The amount of ammonium nitrate was divided into two equal doses applied in March and July of both seasons calcium super phosphate was applied once in December in both seasons. The full does of mineral N+P fertilizer (100%) was 3 Kg ammonium nitrate +1 Kg calcium super phosphate per tree. Bio-fertilizer were applied once in May. The experiment trees were subjected to seven treatments as follows:
Control (farm treatments 3kg ammonium nitrate + 1kg calcium super phosphate per tree.) 50% nitrogen fertilizer(1500 g /tree ammonium nitrate) + 100 g Nitrobin.

- 25% nitrogen fertilizer (750 g /tree ammonium nitrate)+ 200 gNitrobin.
- zero% nitrogen fertilizer(zero g /tree ammonium nitrate) + 300 gNitrobin.
- 50% phosphorous fertilizer (500 g/tree calcium super phosphate) +100 gPhosphorin.
- 25% phosphorous fertilizer (250 g /tree calcium super phosphate) +200 g Pphosphorin.
- zero% phosphorous fertilizer(zero g calcium super phosphate)+300 g Phosphorin.

The experiment was designed as randomized complete block design with seven treatments . Treatments were arranged in three replications (each has 5 trees) for each treatment (7 treatment x3 replicates x 5trees)=105 trees. Mineral fertilizers were broadcasted on the soil surface and trees were irrigated after application .The height of the tree, the canopy and trunk diameter were measured at the beginning of the experiment and at the end to calculate increment . A simple of 8 leaves was randomly selected from the middle part of non-fruiting shoots of each tree in September in both seasons ,the leaves were washed with tap and distilled water , weighed and oven dried at 65-70 ◦c to a constant weight . The dried leaf tissues were ground and digested with sulphuric acid and hydrogen peroxide as mentioned by Evenhius and Dewaard (1980).Suitable aliquots were taken for the determination of colorimetrically according to Evenhuis (1976) and Murphy and Riley(1962). Potassium was determined by a flam photometer . In order to determine fruit physical and chemical characteristics a sample of 5 fruits was randomly taken from each tree at harvest time (February) and averages of fruit weight , length and diameter were measured .The percentage of total soluble solids (TSS%) with a hand refractometer. Acidity% as citric acid and vitamin C (mg ascorbic acid100 ml juice) were determined according to A.O.A.C. (1995). Finally, all data obtained were statistically analyzed according to Snedecor and Cochran (1989) . Data were analyzed as randomized complete block design according to (SAS 1988).

Results and Discussion

Growth measurements

With regard to Growth measurements Table (2) showed that canopy growth increment was significantly higher with all treatments as compared with control except those with 300g Nitrobin. The trees height and trunk diameter increment were significantly greater by all treatments as compared with control increment. These results were in agreement with (Hammas,2003

;on banana , Solaiman et al,2003; on Balady orange, Usha *et al* ,2003; on mandarin , Mohamed ,2005; on citrus rootstocks, Yousif Afaf and Marzouk Hend ,2005; on guava , Ali Nadia *et al* ,2007; on Valencia orange, Wassel *et al* ,2007;on Balady mandarin ,Sharma and Kumar ,2008; on mango , Shehata Wafaa ,2008; on olive and El-Sisy ,Wafaa *et al* ,2011; on guava) .They found that bio-fertilizer combination with nonorganic fertilizer enhance growth measurements.

Fruit quality.

With regard to fruit quality the data presented in Table (3&4) indicated a significant increase in fruit weight in both seasons by applying 500 g calcium super phosphate +100g Phosphorin ,300 g Phosphorin ,750 g ammonium nitrate+100g Nitrobin and 300g Nitrobin treatments as compared with the control in both seasons . In addition ,750 g ammonium nitrate +200g Nitrobin , 500 g calcium super phosphate +100g Phosphorin and 300 g Phosphorin treatments gave a significant increase in fruit diameter in first season as compared with the control .Whereas , 500 g calcium super phosphate +100 g Phosphorin treatment showed a significant increase in fruit diameter in the second season as compared with the control. Fruit length was not affected by any of the treatments in the first season .However 500 g calcium super phosphate +100 g Phosphorin treatment showed a significant increase in fruit length in the second season as compared with the control . Furthermore, total soluble solids did not show any significant differences by any of the fertilization treatments. However, 750 g ammonium nitrate+ 200 g Nitrobin treatment caused a significant increase in acidity in both seasons as compared with the control. Fruit Vitamin C increased significantly by the application of 500 g calcium super phosphate + 100g Phosphorin ,250 g calcium super phosphate +200 g Phosphorin and 300 g Phosphorin treatments in the second season as compared with the control. Whereas , juice volume was not affected by any treatments .These results are in agreement with those reported by(Mansour ,1998; on apple, Mostafa ,2002; on Washington navel orange and, Salama ,2002; on Balady mandarin) . Also , (Akl *et al* ,1997;) on grapevines who found that Phosphorin and active dry yeast caused highly increase in berry set , (Mansour ,1998) reported that bio-fertilizer were very effective in improving yield of Anna apple ,(Abdle –Hamid ,2002;) , reported that bio-fertilization and bio-stimulant gave the highest fruit volume and weight for olive .Also , Osman ,2003)on Zaghloul date revealed that bio-fertilizer treatment was the best one regarding yield and fruit characteristics for Zaghlool. cv. under Alexandria conditions .

Mineral composition

With regard to mineral composition in Table (5) . Leaf phosphorous significantly increased in the first season with 750 g ammonium nitrate +200g Nitrobin, ,300 g Nitrobin , 500 g calcium super phosphate+100 g Phosphorin and 300 g Phosphorin treatments. and with 250 calcium super phosphate fertilizer+200 g Phosphorin treatment in season as compared with the control. Whereas in the first season leaf nitrogen increased with all treatments as compared with the control. Also, applying 300 g Phosphorin significantly increased leaf nitrogen and potassium content in the second season as compare with control. These are similar to those found by (Abd EL-Moniem,

Eman and Radwan 2003; on banana , Solaiman *et al.* 2003; on Balady orange, Usha *et al.* 2003;on mandarin EL-Sharkawy and Mehaisen,2005;on guava , Mohamed (2005) on citrus rootstocks ,Sharawy (2005) on Balady lime, Yousif Afaf and Marzouk Hend ,(2005;on guava, Abd EL-Migeed *et al.* 2007; on Washington navel orange ,Ali Nadia *et al.* 2007; on Valencia orange, Wassel *et al.* 2007; on Balady mandarin, Shaban and Mohsen ,2009 ;on citrus rootstocks and El-Sisy,Wafaa *et al.* 2011; on guava) .They found that bio-fertilizer combination with nonorganic fertilizer increase N,P and K content.

Conclusion

Canopy growth increment had a significant increase with all treatments except those with 300 g Nitrobin as compared with control increment. The trees height and trunk diameter increment were significantly greater by all treatments as compared with control increment. 750 ammonium nitrate +200 g Nitrobin treatment increased Leaf phosphorous and fruit diameter in 2010, fruit weight , juice volume and acidity in both seasons as compared with the control. Also , 300g Nitrobin, treatment increased acidity , leaf phosphorous and nitrogen in 2010 and fruit diameter in 2011 and fruit weight in both seasons as compared with the control .Furthermore ,500 g calcium super phosphate + 100 g Phosphorin treatment increased Leaf phosphorous and juice volume in 2010 ,fruit length and Vc in 2011and fruit weight and diameter in both seasons as compared with the control .In addition,250 g calcium super phosphate + 200 g Phosphorin treatment leaf nitrogen and juice volume in 2010 and leaf phosphorous and Vc in 2011.Moreover, 300g phosphorin treatments increased fruit diameter and leaf phosphorous in the first , juice volume ,Leaf potassium and nitrogen in the second season and fruit weight in both seasons as compared with the control. Whereas in the first season leaf nitrogen increased with all treatments as compared with the control.In general bio-fertilizer combination with nonorganic fertilizer increase increased growth measurements, N and P content and improve fruit quality.

Table (1) Soil analysis of the experimental orchard

Soil depth (cm)	Texture *	EC dS/m	pH	Cations (meq/l)				Anions (meq/l)		
				K^+	Na^+	Ca^{++}	Mg^{++}	HCO_3^-	Cl^-	SO_4^-
0-30	SL	1.5	7.29	0.69	6.96	5.34	2.99	3.8	5.46	6.86
30-60	SL	1.42	7.3	0.42	8.16	3.25	2.66	1.4	5.78	7.72
60-90	SL	1.21	7.1	0.37	14.72	2.45	3.02	1.3	8.24	7.83

*SL Sandy loam

Table (2) Effect of mineral and bio-fertilizer on Canopy growth, height of tree and trunk diameter, of Washington Navel Orange

Treatments	Canopy growth Increment(m)	The height of tree increment(m)	Trunk diameter Increment(m)
Control	0.087	0.092	0.0202
1500 g ammonium nitrate + 100gm Nitrobin	0.139	0.127	0.0300
750g ammonium nitrate +200gm Nitrobin	0.129	0.114	0.0308
Zero g ammonium nitrate +300g Nitrobin	0.104	0.129	0.0315
500 g calcium super phosphate +100g PhosphorIn	0.143	0.145	0.0320
250 g calcium super phosphate +200g Phosphorin	0.126	0.121	0.0280
Zero g calcium super phosphate +300g Phosphorin	0.135	0.110	0.0314
L.S.D	0.067	0.0.097	0.0037

Table(3) Effect of mineral and bio-fertilizer on fruits weight, fruit diameter and fruit length of Washington Navel Orange

Treatments	Fruits weight(g)		Fruit diameter(cm)		Fruit length(cm)	
	2010	2011	2010	2011	2010	2011
Control	123	136	7.2	7.3	7.3	7.4
1500 g ammonium nitrate + 100g Nitrobin	209	230	7.5	7.3	7.5	7.4
750g ammonium nitrate +200g Nitrobin	245	269	8.4	7.5	7.7	7.5
Zero g ammonium nitrate +300g Nitrobin	236	260	7.9	7.4	8.0	7.8
500 g calcium super phosphate +100g PhosphorIn	295	327	8.3	7.9	8.3	8.2
250 g calcium super phosphate +200g Phosphorin	210	231	7.7	7.3	7.8	7.2
Zero g calcium super phosphate +300g Phosphorin	249	274	8.5	7.5	8.3	7.6
L.S.D	97.37	102	0.77	0.53	1.57	0.53

Table (4) Effect of mineral and bio-fertilizer on T.SS ,Acidity ,VC and Juice volume of Washington Navel Orange

Treatments	Total soluble solids (%)		Acidity(%)		V.C(mg ascorbic acid100 ml juice)		Juice volume(cm^3)	
	2010	2011	2010	2011	2010	2011	2010	2011
Control	11 .1	10.9	1.55	1.55	45	47	108	98
1500 g ammonium nitrate + 100g Nitrobin	11.4	11.13	1.5	1.6	48	50	86	78
750g ammonium nitrate +200g Nitrobin	10.6	10.9	1.9	1.8	50	62	138	124
Zero g ammonium nitrate +300g Nitrobin	10.6	10.8	1.8	1.7	50	56	98	88
500 g calcium super phosphate +100g PhosphorIn	10.9	10.8	1.8	1.7	48	73	135	121
250 g calcium super phosphate +200g Phosphorin	11.2	10.9	1.63	1.6	49	67	124	112
Zero g calcium super phosphate +300g Phosphorin	11	1.1	1.6	1.5	47	68	116	93
L.S.D	1.37	1.06	0.27	0.24	6.68	16.4	32.93	29.42

Table(5) Effect of mineral and biofertilizer on leaf Nitrogen, leaf phosphorous, leaf potassium of Washington Navel Orange.

Treatments	Leaf Nitrogen		Leaf phosphorous		Leaf potassium	
	2010	2011	2010	2011	2010	2011
Control	1.30	2.31	0.230	0.250	2.02	1.99
1500 g ammonium nitrate + 100g Nitrobin	2.49	3.06	0.286	0.323	2.12	2.90
750g ammonium nitrate +200g Nitrobin	2.21	3.10	0.307	0.381	2.60	1.62
Zero g ammonium nitrate +300g Nitrobin	2.87	2.89	0.317	0.346	1.80	2.85
500 g calcium super phosphate +100g PhosphorIn	2.17	2.79	0.312	0.352	1.96	1.62
250 g calcium super phosphate +200g Phosphorin	2.50	3.10	0.263	0.407	2.34	2.88
Zero g calcium super phosphate +300g Phosphorin	2.00	3.22	0.294	0.361	2.54	3.10
L.S.D	0.374	0.822	0.638	0.155	1. 1	0.99

References

Abdel- Hameed,.A.A. 2002.Response of *Manzanillo Olive* Trees to Nitrogen and Bio-fertilizer Under Northen Western CoastbConditions pp.84-88. M,Sc. Thesis .Fac .AGRIC ,Cairo .Univ ,Egypt.

Abd EL-Migeed ,M.M.M,M.M.S. Saleh and E.A.M. Mostafa .2007. The beneficial effect of minimizing mineral nitrogen fertilization on Washington Navel orange trees by using organic and bio-fertilizers. World Journal of Agriculture Sciences .3(1):80-85

Abd EL-Moniem- Eman A.A. and S.M.A. Radwan .2003. Response of Willliams banana plants to bio fertilization in relation to growth , productivity and fruit quality .Arab Univ. J.Agric.Sci,.Ain Shams Univ.,Cairo ,11(2) :751-763

Akl. A. M .; F.F .Ahmed.; F.M .El-Morsy and M.A Ragab . 1997. The beneficial effects of bio-fertilizer on Red Roomy grapevines (Vitis vinifera,L.)2-The effect of berry set, yield and quality of berries Annals of Agric .Sci ,Moshtohor ,35:497-502.

Ali, Nadia A.A., B.M. Soliman and M.A. Hassan .2007.Effect of Azotobacter and different sources of organic matter on growth and nutrition of Valencia seedling in new soil .J.Agric.Sci. Mansoura Univ.,32(10):8553-8573.

A.O.A.C(Association of Official Agriculture Chemists) .1995 .Official of Method of Analysis.15th Ed . published by A.O.A.C., Washington,DC(USA)

EL-Sharkawy, Sh.M.M and S.M.A. Mehaisen .2005. Response of guava trees to bio fertilization . Minufia J .Agric.Res. Vol. 30 No. 2:673-688.

EL-Sisy, Wafaa. A.;Mervat , Souror and Eman ,EL-Said .2011. Effect of using bio and mineral fertilizers on growth, yield and fruit quality of Guava cv .Seedling Montkab. Alexandria Science Exchange Journal 32,No(1)76-83.

Evenhuis, B. .1976. Nitrogen Determination. Dept. Agric. Res. Royal Tropical Inst., Amsterdam.

, B . andP.W.Deward .1980. Principles and Practices in Plant Analysis .FAO Soil Bull .38:152-163

FAO(1994).Fertilizer Year –Book ,44

Frankenberger,W.T and M.J.R. Arshed .1995. Phytohormones solid (Microbial production and function) . Marcel Dekker,Inc.Publisher,270 **Madison Avenue ,New York ,USA**

Hammas,M.S. 2003. Effect of bio-fertilization on growth and fruiting of Cavendish and Williams bananas . Egypt J.Hort.30,No.1-2pp 67-81

Mansour,A.E.M. 1998 .Response of Anna apples to some biofertilizers .Egypt. J.Hort .,25(2):241-251

Mohamed , H.S.A. 2005 .Studies on the physiological effect ofof bio-fertilization and growing media on some citrus rootstocks .M.Sc. Thesis,Fac.Agric .,EL-Fayoum,Cairo University ,Egypt.

Moustafa. M.A.(2002). Studies on fertilization of Washington navel orange trees. Ph.D .Dissertation Fac .of Agric. Moshtoher ,Zagazig Uni, Benha Branch, Egypt.

Murphy,J.and J.P.Riley .1962 . A modified single solution method for determination of phosphate in natural water .Anal.Chem.Acta , 27:31-36

Osman S.M.(2003) .Effect of bio- fertilizer on fruit physical and chemical properties of Zaghloul date palm ..Annals Agric.Sci,Ain Shams Univ,Cairo, 48 (1): 297-305.

Osman ,S.M. 2010 .Effect of mineral ,bio-NPK soil application of young olive trees and foliar fertilization on leaf and shoot chemical composition .Research Jornal of Agriculture Biological Sciences , 6 (3): 311-318.

Salama .A.S.M. 2002 .Response of some fruit species transplant and trees to organic fertilization .Ph.D. thesis, Fac. Agric, Moshtoher ,Zagazig Uni, Benha Branch, Egypt.

SAS Institute, 1988. SAS/STAT Users guide, version 8.1. SAS Institute, Carey, NC.

Shaban ,A.E.A. and A.T.Mohsen .2009. Response of citrus rootstocks and transplants to bio-fertilizers .J. Hort .Sci.&Omamen. Plants, 1(2):39-48.

Sharawy,A.M.A . 2005. Response of Balady lime trees to organic and bio-fertilization .Minia J.of Agric .Res.& Develop. Vol.(25)No.1pp:1-18.

Sharma,S.D.and P.Kumar .2008. Relationship of arbuscular mycorrhizal fungi and Azotobacter with plant growth,fruit yield ,soiland leaf nutrient status of mango orchards in North –Western Himalayan region of India. Journal of Applied Horticulture, 10(2):172-178.

Shehata,Wafaa A.E.A.M.; .2008. Studies on bio-fertilization of olive transplants .M.Sc. Thesis in Pomology ,Fac .Agric ; Cairo Univ Egypt.

Snedecor, G.W. and W.G. Cochran .1989 . Statistical Methods, 7th Edn, Ames. Iowa, USA State univ. Press 507pp.

Solaiman,B.M; Nadia .A.A.Ali and S.M. Ahmed . 2003. Response of Balady orange trees productivity and some microbial activity to bio-fertilizer in reclaimed soil. Eleventh Conference of the Egyptian Society of Applied Microbiology Cairo, 12-14 October.

Usha,K.:A.Saxena and B.Singh .2003. Rhizosphere dynamics influenced by arbuscular mycorrhizal fungus (Glomus Deserticola)and relted changes in leaf nutrient status and yield of Kinnow mandarin King (Citrus nobilis)xWillow leaf (citrus deliciosa) Australian Journal of Agricultural Research 55,1-6.

Wassel,A.H.:M.A.Mohamed ;M.A.Ragab :R.A.Sayed and Y.A.Hussein .2007. Influence of biofertilization and method of potassium application on the growth and yield of Balady (Citrus reticulate ,Blanco).1 Inter .Conf. Desert Cultivation Problems&Solutions ,Minia University,27-29March.

Yousif- Afaf .M.A. and Hend A .Marzouk .2005. Comparative studies of using mineral and bio-fertilizer on growth and of guava .Journal of Advances in Agricultural Research ,Vol.10 NO .(2):P.283-292.

الملخص العربى

تاثير التسمِيد المعدنى والحيوى على النمو الخضرى وجودة الثمار والمحتوى المعدنى لاشجار البرتقال ابو سرة

د.هالة محمد الخياط د. حسن على العشرى

مركز البحوث الزراعية – معهد البساتين– مصر

اجريت الدراسة الحالية خلال موسمى الدراسة 2010 و2011 بمزرعة بساتين البوصيلى –مركز البحوث الزراعية لدراسة تاثير معدلات التسميد المعدنى (N,P) والتسميد الحيوى (نيتروبين وفوسفورين) مضافة او منفردة على النمو الخضرى والمحتوى المعدنى وصفات جودة الثمارلاشجار البرتقال ابو سرة عمر 15 عاما النامية فى تربة رملية واضيف التسميد فى سبعة معدلات الكنترول (معاملات المزرعة) وتم تقليل التسميد المعدنى (50%و40%و25%) واضافة التسميد الحيوى كبديل اما نيتروبين (100و200و300 جرام) او فوسفورين(100و200و300 جرام).

واظهرت النتائج الاتى:

1. ادت كل المعاملات لزيا دة محيط الشجرة فيما عدا المعاملة ب 300جرام نيتروبين ايضا ادت كل المعاملات لزيا دة ارتفاع الشجرة ومحيط الجذ ع بالمقارنة بالكنترول.
2. ادت المعاملة ب 750 جم نترات امونيوم+200جرام نيتروبين الى زيادة محتوى الثمار من الحموضة وحجم العصير و ووزن الثمار فى الموسمين ايضا زيادة محتوى الاوراق من الفوسفور وقطر الثمار و فى الموسم الاول بالمقارنة بالكنترول.
3. ادت المعاملة 300جرام نيتروبين الى زيادة محتوى الاوراق من النيتروجين والفوسفور وحموضة الثمار فى الموسم الاول و قطر الثمار فى الموسم الثانى و زيادة وزن الثمار فى الموسمين بالمقارنة بالكنترول.
4. ادت المعاملة ب 500جرام سوبر فوسفات الكالسيوم و100جرام فوسفورين الى زيادة محتوى الاوراق من الفوسفو ر وحجم العصير فى الموسم الاول و طول الثمار ومحتوى الثمار منvc فى الموسم الثانى ووزن وقطر الثمار ر فى الموسمين بالمقارنة بالكنترول.
5. ادت المعاملة ب 250جرام سوبر فوسفات الكالسيوم 200جرام فوسفورين لزيادة محتوى الاوراق من النيتروجين وحجم العصير فى الموسم الاول و محتوى الاوراق من الفوسفور ومحتوى الثمار منvc فى الموسم الثانى بالمقارنة بالكنترول.
6. ادت المعاملة ب 300جرام فوسفورين لزيادة قطر الثمار و محتوى الاوراق من الفوسفو ر فى الموسم الاول محتوى الاوراق من البوتاسيوم و النيتروجين وحجم العصير فى الموسم الثانى وزن الثمار فى الموسمين بالمقارنة بالكنترول.
7. ايضا ادت كل المعاملات لزيادة محتوى الاوراق من النيتروجين فى الموسم الاول بالمقارنة بالكنترول.