Journal homepage www.jzs.univsul.edu.iq
Journal of Zankoy Sulaimani
Part-A- (Pure and Applied Sciences)

Effects of foliar application of urea and potassium chloride on some physicochemical properties of "Damson "plum fruits

Ali Muhi Aldeen Omar Aljabary

Department of Horticulture, Technical College of Applied Sciences-Sulaimani Polytechnic University, Kurdistan Region-Iraq
Email: ali.omar@spu.edu.iq

Article info

Original: 09/12/2017
Revised: 30/01/2018
Accepted: 06/02/2018
Published online:

KeyWords: Damson Plum, Potassium Chloride, Urea.

Abstract

This study was carried out on Damson Plum trees(*Prunus domestica* L.) selected from orchard during 2015 growing season in Brzinjah district, Sulaimani governorate, Iraqi Kurdistan Region, to investigate the effect of different level of urea (0, 0.5 and 1%), and potassium chloride (KCl) (0, 1and 2%) on some physicochemical properties of plum fruits. Trees were sprayed with Urea and potassium chloride at two different times, early May, and early June, 2015. The results shows that, spraying with 0.5% urea cased a significant decrement of moisture and pectin percentage of fruit and increased the dry matter and peroxidase enzyme activity, while the high level of urea (1%) decreased significantly fruit size, pulp/fruit percentage and pulp/seed percentage.

The foliar spray with 2% of Potassium Chloride led to significant increase in the value of fruit size, fruit diameter, pulp/fruit percentage, and pulp/seed percentage, while significant decrease in peroxidase enzyme activity compared with control treatment. On the other hand, the Treatment combinations between spray of 0.5% urea and 2% KCl gave the highest means of fruit size, fruit length, fruit diameter, pulp/fruit percentage and pulp/seed percentage.

Introduction

Plum is a fruit of the Rosaceae family which contain some types: Japanese plums (*Prunus salicina* Lindell) is originated in China and cultivated in Japan 400 years ago, mainly used for fresh consumption, European plums (*Prunus domestica* L.), are originated in the Near East and with a long history of cultivation, especially in Europe, can be used as fresh or dried. The dried plums are known prunes [1]. Previous reviews of plum phytochemical content and health benefits have concentrated on the European plum[2].

Nitrogen and potassium are essential nutrients required by plants that recorded by [3]. However, owing to excessive nitrogen supply, the negative effect on the stone fruits quality such as decrease flesh hardness and sweetness [4]. Otherwise, [5] mentioned that nitrogen deficiency caused decrease in fruits size, although, the stone fruit characteristic did not impacted by nitrogen use in Brazil [6, 7].

Potassium is enhancing root growth and tree vigor, raising yield and improving fruit quality and plant defiance to dryness [8]. Plum trees are grown in Barzinjah district, where the soil is alkaline, producing small fruits. In this type of soil depressing of potassium uptake is a nutritional problem, especially trees cultivated in Rain-fed. The absorption of nutrient material through plant surfaces may happen by: (1) The cuticle, (2)

Cuticular splits and defects, and (3) Stomata, trichomes, lenticels [9]. Foliar feeding is become more active when soil nutrient availability decreased, topsoil dry, and root activity reduced during the generative stage, that reported by [10]. Excessive soil fertilization in addition to the economic aspects, has increase the contamination of ground and stream water that recorded by [11]. Thus, the foliar feeding is the best, especially in these aspects. Sulaimani governorate is the major producer of plums that cultivated in rain-fed areas of northern Iraq. To our knowledge, till now there is no investigation concerning of plum fruits properties. Thus, the objective of this investigation was to evaluate the effects of spraying with urea and potassium chloride doses on some physical and chemical parameters of Damson plum fruits.

Materials and Methods

The present study was laid out in a private orchard located at Brzenjh district, Sulaimani governorate, Iraqi Kurdistan Region. 27 trees of 'Damson ' Plum *Prunus domestica* L. budded on bitter almond were selected. The trees were 13 years old, uniform in size and strength and cultivated at 3 × 4 m. This investigation involved two factors; the first urea spraying (0, 0.5 and 1%), and the second was potassium chloride (KCl) spraying (0, 1and 2%), these treatments were lay out in Randomized Complete Block Design with three replicates (RCBD) and one tree was utilized as an experimental unit. The influence of these applications on some physical and chemical properties of plum fruits was studied. Trees were sprayed two different times, in May, and early June, 2015, at the morning until full dripping using 16L back sprayer.

1. Physical parameters:

During harvesting (at commercial maturity stage (on 7th Sept.)), 10 ripe fruits were randomly picked up from each tree to study the average of fruit size (cm^3). The size was measured by using the liquid displacement method, fruit length (cm) and fruit diameter (cm) were measured by caliper, pulp/fruit (%), seed/fruit (%), pulp/seed (%) were also determined.

2. Chemical parameters:

Moisture content (%):

The percentage of moisture content of fruits was calculated according to [12]. Fruits were dried at 67°C in an oven for 24–48 hours, and the moisture content was estimated by the following equation:

Moisture (%) = (fresh weight - dry weight) x 100/ fresh weight.

Dry Matter (%):

The percentage of dry matter of fruits was determined by the following equation:

Dry matter (%) = (dry weight/fresh weight) x 100.

Pectin (%) :

The percentage of pectin was calculated according to[13] by taking 10 g of the fruits pulp and 50 ml of NaOH 1 N was added to the sample. Then, it was left in the dark place for 10 hours, before adding 25 ml of acetic acid 1 N. The sample was left for 5 minutes, and 25 ml of calcium chloride solution was added. The mixture was left for one hour, and boiled for 10 minutes, then filtrated. The sediment was washed by the hot distilled water, and the process was repeated 5 times to be free from chloride, Silver nitrate was used as an indicator to assuring the absence of chloride. After obtaining a free chloride sediment, the deposit was transferred into the filter paper (the weight was known), then drained 90˚C for 12 hours. The percentage of pectin in the form of calcium pectate was estimated according to the following equation:

The percentage of calcium pectate = sediment weight after drying/sample weight x 100.

While the amount of pectin was calculated on the basis that the amount of calcium in the calcium pectate is 7.61%.

Peroxidase enzyme activity (POD):

The peroxidase enzyme activity in the fruits (POD) was estimated concurring to [14], Samples of 10 g were mixed with 100 ml of 0.05 M potassium phosphate buffer at pH 7.0. The blend was centrifuged at 20000 x g for 15 minutes and the supernatant was checked for POD activity. It was determined by gauging

the color development at 400 nm in enzyme extract mixed with hydrogen peroxide and guaiacol. One ml of the enzyme extract was mixed with 1 ml of 0.5% of hydrogen peroxide, 1 ml of 0.5% of guaiacol and 18 ml of sodium phosphate buffer at pH 6.5. Color development was calculated by UV spectrophotometer as a variation in absorbance of 0.001/min.

Statistical analysis:

Data were exposed to the analysis of variance and a randomized complete block design (RCBD) was used [15], and the means were compared with (Multiple Duncan test, at 0.05) using SAS program version 9.1[16].

Results and Discussion

Physical properties

Fruit size (cm^3)

The results in Table 2 show that fruit size was significantly decreased with the urea increasing; the smallest fruits were produced by the 1% urea. It may be come back to the physiological role of nitrogen to promotes the creating of chlorophyll which results in creating of endogenous auxins and that its prevents the abscission and helped fruits to remain attached with the shoot, causing in lower fruit drop that reported by [17]. Or it might be due to the nitrogen feature to diminish the cell wall thickness, which in consequence decreases the flesh texture [18, 19]. This might be led to making small fruits with the increased concentration of urea. Same pathway was figured concerning of the pulp/fruit percentage, while the fruit size was significantly boosted with increment of potassium chloride concentration. The largest size was obtained from spraying the trees with 2% potassium chloride. The positive effect of potassium in improving fruit size could be attributed to its important role in stimulating and improving the metabolic process during the uptake, root activation, regular water balance and translocation compounds which in turn increases the growth, then reflected on physical characteristics of fruits [20]. Such findings are in harmony with those reported by some other researchers [21-23]. There were positive correlations between fruit size and each of fruit diameter, pulp/fruit percentage and pulp/seed percentage, while negative correlations was obtained with seed/fruit percentage at 0.01 level (Table 1). However, the maximum size was significantly produced with the interaction between 0 or 0.5% urea and 2% KCl compared with the other interaction treatments. While, the minimum size was 1% urea and 0 % KCl (Table 3).

Table -1: Correlations coefficient between physical fruit properties

	Fruit Size (cm^3)	***Fruit length (cm)***	***Fruit diameter (cm)***	***Fruit shape***	***Pulp / fruit (%)***	***Seed / fruit (%)***	***Pulp / seed (%)***
Fruit Size	*1*						
Fruit length	*0.90849 ** *	*1*					
Fruit diameter	*0.96145 ** *	*0.87027 ** *	*1*				
Fruit shape	*0.26657 n.s*	*0.60899 n.s*	*0.15153 n.s*	*1*			
Pulp/ fruit (%)	*0.99309 ** *	*0.87824 ** *	*0.93459 ** *	*0.23054 n.s*	*1*		
Seed/ fruit (%)	*-0.99309 ** *	*-0.87824 ** *	*-0.93459 ** *	*-0.23054 n.s*	*-1.00000 ** *	*1*	
Pulp/seed (%)	*0.99334 ** *	*0.89530 ** *	*0.93372 ** *	*0.26526 n.s*	*0.99909 ** *	*-0.99909 ** *	*1*

n.s = Non-significant. * = Significant at 0.05 level of probability. ** = Significant at 0.01 level of probability.

Fruit Length (cm)

The results in Table 2 show that non-significant effect on fruit length by foliar spray of urea. While the highest fruit length was obtained from the high concentration of potassium chloride. The present results are in conformity with those reported previously by [24-26]. Positive correlations were conducted for fruit length with each of fruit diameter, pulp/fruit percentage and pulp/seed percentage, while the negative correlation was obtained with seed/fruit percentage at 0.05 levels (Table 1). That was agreement with [27] in date palm. The interaction of 0.5% urea and 2%KCl gave the highest value, while the lowest value was noticed in fruits treated with 1% urea and 1% KCl.

Fruit diameter (cm)

Data presented in Table 2 showed that spraying with urea had non-significant effect of the fruit diameter. The significant effect and highest fruit diameter was registered by spraying with 2% KCl compared to 0, 1% KCl, while the lowest value was recorded to the untreated fruits. The present results were founded similar with what was reported by [24-26]. Positive correlations were observed for fruit diameter with each of pulp/fruit percentage and pulp/seed percentage, while negative result was obtained with seed/fruit percentage (Table 1). The result in Table 3 declared significant and maximum value of fruit diameter in fruits treated with 0.5% urea and 2% KCl. On the reverse, the minimum value of this parameter was gained by 1% urea and 0 % KCl.

Table -2: Effect of spraying with urea and potassium chloride on some physical properties of plum fruits at harvest

Urea %	*Fruit Size (cm^3)*	*Fruit Length (cm)*	*Fruit Diameter (cm)*	*Fruit Shape*	*Pulp/Fruit (%)*	*Seed/ Fruit (%)*	*Pulp / Seed*
0	*22.01 a*	*3.21 a*	*2.87 a*	*1.12 a*	*92.21 a*	*7.79 b*	*11.95 a*
0.5	*21.47 b*	*3.23 a*	*2.89 a*	*1.12 a*	*92.00 ab*	*8.00 ab*	*11.64 a*
1	*20.36 c*	*3.06 a*	*2.84 a*	*1.08 a*	*91.70 b*	*8.30 a*	*11.07 b*
Potassium chloride%							
0	*19.63 c*	*3.21 a*	*2.78 b*	*1.12 a*	*91.50 c*	*8.50 a*	*10.79 c*
1	*20.78 b*	*3.23 a*	*2.84 b*	*1.08 a*	*91.90 b*	*8.10 b*	*11.42 b*
2	*23.42 a*	*3.06 a*	*2.98 a*	*1.11 a*	*92.51 a*	*7.49 c*	*12.44 a*

Means within a column and factor followed the same letters are not significantly different from each other according to Duncan's multiple range test at 0.05 level.

Table -3: Effect of the interaction between spraying with urea and potassium chloride on some physical properties of plum fruits at harvest

Urea %	*Potassium Chloride %*	*Fruit Size (cm^3)*	*Fruit Length (cm)*	*Fruit Diameter (cm)*	*Fruit Shape*	*Pulp/Fruit (%)*	*Seed/ Fruit (%)*	*Pulp / Seed (%)*
	0	*19.50 d*	*3.01 bc*	*2.74 b*	*1.10 a*	*91.17 cd*	*8.83 a*	*10.33 cd*
0	***1***	*21.77 b*	*3.31 ab*	*2.86 ab*	*1.16 a*	*92.65 a*	*7.35 c*	*12.62 a*
	2	*24.77 a*	*3.32 ab*	*3.00 a*	*1.11 a*	*92.79 a*	*7.21 c*	*12.91 a*
	0	*21.07 c*	*3.26 ab*	*2.88 ab*	*1.13 a*	*91.89 bc*	*8.11 b*	*11.36 b*
0.5	***1***	*19.17 d*	*3.08abc*	*2.77 b*	*1.11 a*	*91.10 d*	*8.90 a*	*10.24 d*
	2	*24.17 a*	*3.34 a*	*3.04 a*	*1.10 a*	*93.01 a*	*6.99 c*	*13.30 a*
	0	*18.33 e*	*3.04abc*	*2.72 b*	*1.12 a*	*91.43 bcd*	*8.57 ab*	*10.68 bcd*
1	***1***	*21.40bc*	*2.87 c*	*2.89 ab*	*0.99 b*	*91.94 b*	*8.06 b*	*11.41 b*
	2	*21.33bc*	*3.28 ab*	*2.90 ab*	*1.13 a*	*91.74 bcd*	*8.26 b*	*11.12 bc*

Means within a column followed the same letters are not significantly different from each other according to Duncan's multiple range test at 0.05 level.

Fruit shape index (length/diameter ratio)

It can be says that most of fruits obtained in the experiment were elliptical in shape. Data in Table 2, show non-significant differences in fruit shape for all level of urea and potassium chloride were applied. There was no-significant correlation between fruit shape and all other properties (Table 1). According to fruit shape analysis presented in Table 3, all interaction treatments were significantly superior on the lowest percentage in the fruits treated with 1% urea and 1% KCl.

Pulp/fruit (%)

The high urea level had significantly decreased the pulp per fruit percentage compared to the control. However, with the increased level of potassium chloride (from 1 to 2%), pulp per fruit percentage was significantly increased. Hence, the highest percentage was achieved by 2% KCl (Table 2). This result may be due to important role of potassium in increasing photosynthesis and increased the synthesis of nutrients [28]. These nutrients will be used in enhancing cell division, growth and the development of leaf. Potassium also has an important role in activation of vegetative growth. The result in Table 1 shows that positive and negative correlations were present between pulp/fruit percentage with pulp/seed percentage and seed/fruit percentage, respectively. Result in Table 3 shows that the interaction between 0.5% urea and 2% KCl was significantly increased pulp/fruit percentage compared with control and interaction treatment between 0.5% urea and 1% potassium chloride which gave the lowest value of this characteristic.

Seed/fruit (%)

The result presented in Table 2 indicated that, seed/fruit percentage was significantly increased by increasing urea concentration compared with the control. Concerning the influence of potassium chloride applications, the data revealed that, seed/fruit percentage was significantly decreased with increasing potassium chloride rate. Negative correlation was obtained between seed/fruit percentage with pulp/fruit percentage (Table 1). However, data in Table 3 shows significant different between the interaction treatments in seed/fruit percentage, as the minimum value was come from the interaction between 0.5% urea and 2% KCl, while the maximum percentage was produced with 0.5% urea and 1% KCl treatment.

***Pulp/seed* (%)**

The results in Table 2 show that, lowest ratio was obtained from the high level of urea and decreased significantly compared to control and 0.5% urea treatments. While the reverse happened with KCl levels, hence, the highest percentage was produced by high level of potassium chloride. Data in Table 3 shows the interaction between 0.5% urea and 2% KCl treatment was increased significantly this percentage compared with some interactions. However, the smallest percentage was obtained with the interaction between 0.5% urea and 1% KCl.

Chemical properties

Moisture (%)

Effect of urea foliar application had an effect on moisture content. Treatment of 1% urea had significantly increased moisture content in fruits compared with other treatments. This is conformity with the result of [29] on mango. This increment of moisture in fruit come back to the role of nitrogen in synthesis endogenous auxins and it caused to boost the elasticity and permeability of the cell wall, admitting higher amount of water and dissolved material in cells [30]. Whereas the foliar spraying of potassium chloride of 2% had significantly increased moisture percentage in the fruits compared 1% potassium chloride treatment only (Table 4), tis increment of moisture percentage in fruits might be due to the physiological role of potassium as a regulator in closing and opening of stomata, that recorded by [31]. The interaction between urea and KCl levels had a significant effected on moisture content. The maximum percentage was observed in fruits

treated with 1% urea and 1% KCl, that significantly superior on most of other interacted treatments. Meanwhile, the minimum percentage was produced from 0.5% urea and 1% KCl (Table 5). Concerning the influence of the interaction between different levels of urea and potassium chloride feeding, the interaction between 1% urea and 1% KCl obtained the highest and significant moisture percentage as compared with some of other interaction treatments Table (5).

Table -4: Effect of spraying with urea and potassium chloride on some chemical properties of plum fruits at harvest

Urea %	*Moisture (%)*	*Dry Matter (%)*	*Pectin (%)*	*peroxidase enzyme activity*
0	*78.124 b*	*21.876 b*	*2.061 a*	*6.048 b*
0.5	*77.463 c*	*22.537 a*	*1.807 b*	*7.233 a*
1	*79.096 a*	*20.904 c*	*2.168 a*	*5.848 b*
Potassium chloride%				
0	*78.276 a*	*21.724 b*	*2.026 a*	*6.690 a*
1	*77.776 b*	*22.224 a*	*2.033 a*	*6.504 a*
2	*78.631 a*	*21.369 b*	*1.977 a*	*5.934 b*

Means within a column and factor followed the same letters are not significantly different from each other according to Duncan's multiple range test at 0.05 level.

Table -5: Effect of the interaction between spraying with urea and potassium chloride on some chemical properties of plum fruits at harvest

Urea %	*Potassium chloride%*	*Moisture (%)*	*Dry Matter (%)*	*Pectin (%)*	*peroxidase enzyme activity*
	0	*77.341 c*	*22.659 b*	*2.088 ab*	*6.107 bc*
0	***1***	*77.271 c*	*22.729 b*	*2.143 a*	*5.817 c*
	2	*79.759 a*	*20.241 d*	*1.953 abc*	*6.220 bc*
	0	*79.141 ab*	*20.859 cd*	*1.786 c*	*7.623 a*
0.5	***1***	*76.240 d*	*23.760 a*	*1.866 bc*	*7.603 a*
	2	*77.009 cd*	*22.991 ab*	*1.768 c*	*6.473 b*
	0	*78.345 b*	*21.655 c*	*2.205 a*	*6.340 bc*
1	*1*	*79.817 a*	*20.183 d*	*2.088 ab*	*6.093 bc*
	2	*79.127 ab*	*21.873 cd*	*2.211 a*	*5.110 d*

Means within a column followed the same letters are not significantly different from each other according to Duncan's multiple range test at 0.05 level.

Dry matter (%)

The result in Table 4 indicated the significant effect of various level of urea on the dry matter. Spray with 0.5% urea recorded the highest and significant dry matter percentage as compared to other treatments, on the other hand the lower percentage was obtained in higher level of urea (1%). This result might be due to urea action on converting complex substances into simple, it may be used in respiration process, and as a results decreased the dry matter in fruits treated with 1% urea, whereas, foliar feeding of potassium chloride also influenced significantly on dry matter. The maximum percentage was obtained in fruits spraying with 1% potassium chloride. While the minimum percentage was recorded in fruits treated with 2% potassium chloride. This might be due to the effect of chlorine (Cl) ions, that decreased the potassium uptake, or its accumulation in leaves, that recorded by [32]. Concerning the influence of the interaction between different levels of urea and potassium chloride feeding, the interaction treatment between 0.5% urea and 1% KCl obtained the highest and significant dry matter percentage as compared with other interaction treatments without the interaction treatment between 0.5% urea and 2% KCl Table (5).

Pectin (%)

Data presented in Table 4 showed a significant influence of urea treatments on pectin percentage. The first level of urea (0.5%) decreased significantly pectin percentage of fruits compared the control and second level of urea (1%) treatments that was recorded the highest percentage of pectin. The increased in pectin percentage might be refer to the role of nitrogen in accepting the highest amount of water. Pectins are found relatively under conditions that rapid growth and higher moisture contents cause to large amounts of pectin in soft plant tissues [33]. Concerning the effect on potassium chloride levels of this parameter, non-significant different was recorded between the treatments. The interaction between urea and potassium chloride had significant effect on pectin percentage in fruits. The maximum pectin percentage was recorded in fruits that interacted with high levels of urea and KCl (Table 5).

Peroxidase enzyme activity

Spraying with 0.5% urea had significantly surpassed the other treatments in rising of peroxidase enzyme activity. The reason of this significance, the nitrogen might not have direct effect on this parameter of the fruit but it may facilitate in the uptake of other nutrients which improve the quality of fruits [34]. While, less peroxidase enzyme activity was observed in fruits sprayed with 1% urea, which was not significantly different from the control (Table 4). As well as, the foliar feeding height level of potassium chloride (2%) had significantly decreased of peroxidase enzyme activity. This result might be referring to the role of potassium in enhancing fruit ripening, as a result decreased peroxidase enzyme activity. According to peroxidase enzyme activity analysis the result presented in Table 5 shows that the interaction between 0.5% urea and (0 or 1%) KCl were significantly superior on all other interaction treatments. While, the lowest peroxidase enzyme activity was observed in fruits treated with of 1% urea and 2% KCl.

Conclusion

Foliar application of potassium chloride had significant effected on improving the physical characters of plum fruits. Higher concentrations of urea and potassium chloride had significantly reduced the dry matter and peroxidase enzyme activity compared with 0.5% urea and 1% KCl. Duplex interaction between 0.5% urea and 2% KCl lead to improve all physical properties of the fruits.

Reference

[1] Crisosto, C.H. and Kader A.A. "*Plum and fresh prune postharvest quality maintenance guidelines"* Department of Plant Sciences, University of California, Davis, CA, **95616**. pp. 1-8 (2000).

[2] Stacewicz-Sapuntzakis, M., Bowen P.E., Hussain, E.A., Damayanti-Wood, B.I. and Farnsworth, N.R. "*Chemical composition and potential health effects of prunes: a functional food?"* Critical Reviews in Food Science and Nutrition, Vol. (41), No. 4, pp. 251–286. (2001).

[3] Marschner, H. *"Mineral nutrition of higher plants*" 2nd ed. London: Academic Press. (1995).

[4] Rettke, M., Pitt, T. R. Maier, N. A. and Jones, J. A."*Quality of fresh and dried fruit of apricot (cv. Moorpark) in response to soil-applied nitrogen".* Animal Production Science, Vol. (46), No. 1, pp. 123-129. (2006).

[5] Taylor, K.C. "*Cultural management of the bearing peach orchard"* pp. 1-4 (2009).

[6] Brunetto, G., Melo, G.W. Kaminski, J. and Ceretta, C. A. "*Adubação nitrogenada em ciclos consecutivos e seu impacto na produção e na qualidade do pêssego"* Pesquisa Agropecuária Brasileira, Vol. (42), No. 12, p. 1721-1725. (2007).

[7] Dolinski, M.A. Beatriz, M. S. Antonio, C. V. M. Francine, L. C. Silvana, R. D. S. Louise, L. M. M. and Lino, B. M. "*Produção, teor foliar e qualidade de frutos do pessegueiro'Chimarrita'em função da adubação nitrogenada, na região da Lapa-PR.* Revista Brasileira de Fruticultura, Vol. (27), No. 2, pp. 295-299. (2005).

[8] Mengel, K. and Kirkby, E.A. "*Principles of plant nutrition"* Principles of plant nutrition. (1978).

[9] Fernández, V. Sotiropoulos, T. and Brown, P.H. "*Foliar Fertilization: Scientific Principles and Field Pratices*": International fertilizer industry association. (2013).

[10] Wojcik, P. "*Uptake of mineral nutrients from foliar fertilization [Review]"* Journal of fruit andornamental plant research. Vol. (12), No. Spec. ed. p.201-218(2004).

[11] Cuquel, F.L. Antonio, M. C. V. Inês, T. and Louise, L. M. M. "*Nitrogen and potassium fertilization affecting the plum postharvest quality"* Revista Brasileira de Fruticultura. Vol. (33), No.spel, p. 328-336. (2011).

[12] Horwitz, W., *Official methods of analysis of the AOAC International*. The Association. Vol. 18. (2000).

[13] Rouhani, I. and Bassiri, A. "*Changes in the physical and chemical characteristics of Shahani dates during development and maturity"*. Journal of Horticultural Science. Vol. (51), No. 4. p. 489-494. (1976).

[14] Wahid, M., "*Effect of gamma irradiation and storage on the catalase and peroxidase activities of mushrooms"*. Lebensmittel-Wissenschaft+ Technologie.= Food science+ technology. Vol. (13), p. 292-292. (1980).

[15] Steel, R. and Torrie, J. "*Principles and procedures of statistics. MC Graw hill publishing compagny"* New-York. p.633. (1980).

[16] SAS, *Version 9.1, SAS Institute Inc.* Cary, NC,USA. Vol. 2. (2002).

[17] Jat, G. and Kacha, H.L. "*Response of guava to foliar application of urea and zinc on fruit set, yield and quality"* Journal of AgriSearch, Vol. (1), No. 2. p. 86-91. (2014).

[18] Jia, H., Mizuguchi, K. Hirano, K. and Okamoto, G. "*Effect of fertilizer application level on pectin composition of Hakuho peach (Prunus persica Batsch) during maturation"* HortScience, Vol. (41), No. 7. p. 1571-1575. (2006).

[19] Muramatsu, N., and Toshio Takahara "*Relationship between texture and cell wall polysaccharides of fruit flesh in various species of citrus"* HortScience. Vol. (31), No. 1. p. 114-116. (1996).

[20] Nijjar, G.S., *Nutrition of fruit trees.* (1985).

[21] Gowda, A. "*Effect of some organic manures and potassium addition on growth, yield and fruit quality of Sultani fig trees"* Agriculture Science of Mansoura University, Vol. (32), No. 2. p. 1273-1291. (2007).

[22] Kilany, A. and Kilany, O. "*Effect of potassium and boron nutrients on growth, yield and fruit quality of Anna apple trees"* Bul Facult Agri Uni Cairo, Vol. (42), No. 2. p. 415-28. (1991).

[23] Mikhael, G., *Studied on "Anna" apple fertilization*, in *Fac. Agric.* Tanta Univ.,: Kafr Elsheikh, Egypt. (1994).

[24] Al- Bamarny, S.F. Salman, M.A. and Ibrahim, Z.R. "*Effect of some Chemical Compounds on some Characteristics of Shoot and Fruit of Peach"* Mesopotomia Journal of Agric, Vol . (38) No . (Supplement 1)**.** (2010 a).

[25] Eid, T., Fatama, I. Abou Grah, and Hussein, S. M. "*Effect of Soil Moisture Regimes and Potassium Application on Growth, Yield and Fruit Quality of Canino Apricot (Prunus Armeniaca L.)"* J. Plant Production, Mansoura Univ., Vol. (4), No. 4. p. 621. (2013).

[26] Mikhael, G. Aziz, M. and Abd El-Messeih, W. "*Effect of some flood irrigation and potassium fertilization treatments on vegetative growth, yield and fruit quality of dessert red peach trees grown in clay soil"* Mansoura University Journal of Plant Production, Vol. (1), No. 4. p. 599 - 620. (2010).

[27] Khayyat, M. Tafazoli, E. Eshghi, S. and Rajaee, S. *"Effect of nitrogen, boron, potassium and zinc sprays on yield and fruit quality of date palm"* Am Eurasian J Agric Environ Sci, Vol. (2), No. 3. p. 289-296. (2007).

[28] Robbins, S.C.M. and Dixon, A.R. '*Plant analysis; Mineral nutrient"* Oregon state University, O.s.U. Department of Horticulture, Editor. Corvallis, Oregon 97331; In soil Sci. plant Anal. p. 545-560. (1988).

[29] Attaha, A.H. and Al-Shllal, R.H.H. "*Effect of foliar spray of urea and naphthalene acetic acid on yield and fruit quality of mango " Mangifera indica L.".* Bsra Journal of Science (B), Vol. (29), No. 1. p. 24-46. (2011).

[30] Al-Bamarny, S. Salman, M. and Ibrahim, Z. "*Effect of NAA, KNO 3 and Fe on some Characteristics of Leaf and Fruit of Peach (Prunus persica L.) cv. Early Coronet"* Proceedings of the World Food System-A Contribution from Europe, Tropentag, p. 1-5. (2010).

[31] Ashley, M. Grant, M. and Grabov, A. "*Plant responses to potassium deficiencies: a role for potassium transport proteins.* Journal of Experimental Botany, Vol. (57), No. 2. p. 425-436. (2006).

[32] Borowski, E. and Michalek, S. "*The effect of foliar feeding of potassium salts and urea in spinach on gas exchange, leaf yield and quality"* Acta Agrobotanica, Vol. (62), No. 1. p. 155–162. (2009).

[33] Glicksman, M. "Gum Technology in the Food Industry," Academic Press, New York, (1969).

[34] Sharma, V.K. Tiwari, R. and Chouhan, P. "*Effect of N, P and their interaction on Physico-Chemical Parameters of Guava (Psidium guajava) cv. L-49 under Malwa Plateau Conditions"* International Journal of Scientific and Research Publications, Vol. (4), No. 11. p. 1-4. (2014).