

EFFECT OF POTASSIUM FERTILIZATION ON YIELD AND FRUIT QUALITY OF ‘ PICUAL’ OLIVE TREES UNDER RAFAH CONDITIONS.

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ABSTRACT

This investigation was carried out for two successive seasons (1997 and 1998) on “ Picual” olive trees grown at Rafah ,Northern Sinai Governorate . The experiment included three Levels of potassium sulphate fertilization (namely 300,400 and 500 gm / tree/ year). Each level was added at one or two equal doses during the growing season.

Results showed that the highest yield was produced by 500 gm. potassium sulphate/ tree/ year, applied at two equal doses in the two season of study. Fruit weight, volume, length, diameter and flesh/ Fruit ratio were significantly affected by different treatments specially potassium fertilization at 500 gm. added at two equal doses/ year.

INTRODUCTION

Olive cultivation have an important role in the economy of many countries, where the trees are grown in unsuitable soils for other crops. The fertilization programs in most olive orchards did not take an important place specially potassium fertilization. So the production of such trees became very poor.

Northern Sinai is one of the important areas for producing olive since it represent 12% of the total area of olive in Egypt. So, this trial was carried out to study the best rate of potassium fertilization as well as the proper doses of application with respect to mineral content on yield and fruit quality of Picual olive trees grown at Rafah district.

MATERIAL AND METHODS

This work was conducted through out the two successive seasons of 1997 and 1998 on 20 years old “ Picual” olive trees. The trees were grown in a loamy sand soil located at Rafah, Northern Sinia Governorate. The mechanical and chemical analysis of the soil are presented in table (1)

Table (1). Mechanical and chemical analyses of soil in which the studied, Olive trees are growing at Rafah Northern Sinai Governorate .

A) Mechanical analysis						
Sand %	silt %	clay %	total	soil texture		
80.52	12.68	6.8	100	Loamy sand		
B) Chemical analysis						
Soil Depth Cm	PH	O.M	N %	K %	E.C Dsm-1	cac03 %
0 - 30	8.2	0.50	0.017	0.023	0.13	1.65
30- 60	8.3	0.35	0.015	0.023	0.12	1.69
60- 90	8.3	0.19	0.014	0.020	0.12	1.72

From the data presented in Table (1) concerning the mechanical analysis of the soil comprises of sand 80.52 % silt 12.68 % and clay 6.8 % this soil texture belongs to loamy sand. Concerning the chemical analysis of the soil in Rafah orchard it can be easily noticed that the sand soil of this orchard is generally poor in mineral content especially potassium since it was 0.023 % in depths of 30.0 – 60.0 cm and 0.20% in depth 60-90 cm

Twenty one trees were of normal growth and as uniform as possible were chosen for this study. These selected trees were subjected to flood irrigation.

Seven fertilization treatments in three replicates were arranged in a complete randomized block design.

The experiment involved treatments as follows:

- 1- 300 gm potassium sulphate at one dose (April).
- 2- 400 gm “ “ “ “ “ “ .
- 3- 500 gm “ “ “ “ “ “ .
- 4- 300 gm “ “ “ “ “ “ at two equal doses (April- July)
- 5- 400 gm “ “ “ “ “ “ “ “
- 6- 500 gm “ “ “ “ “ “ “ “
- 7- control (without potassium sulphate).

Leaf mineral content:

Representative samples of mature leaves (7month – old) the 4th and 5th leaves from the base of twigs from each replicate were collected. The samples were thoroughly washed with tap water, rinsed twice with distilled water and oven dried at 70 c to constant weight and finally grounded , 0.3 gram of leaf powdered material was wet ashed using sulphuric acid and hydrogen peroxide. Thereafter the following determinations were carried out in the acid digested solutions as reported by Van Shouwenburg (1968) .

- Nitrogen content was determined by the micro Kieldahl method as described by Pregl (1945).

- Phosphorus content was estimated by the calorimetric method according to Toug and Meyer (1929).
- Potassium content was measured by using flame-photometer as the method described by Brown and Lilleiand (1946).
- Calcium and Magnesium were determined by titration against versenate solution (Na-EDTA) as described by U.S. salinity laboratory staff Anonymous (1954)

Yield / Tree :

Yield was recorded at harvest time (late September) in both seasons.

Fruit oil content% :

Was determined by extracting the oil from the dried fruit samples by means of soxhlet fat extraction using .Petroleum ether of 60-80°C boiling point, as reported in the A.O.A.C (1975).

Fruit Quality:

Representative sample of 25 fruits per tree were collected at the end of September to determinate the following:

- Fruit weight (g) . -Fruit Volume (ml)
- Specific gravity (g/cm³). -Fruit dimensions (cm).
- Fruit shape index. -Flesh / Fruit % .
- Seed weigh: seed which were taken from 25 fruits were weighted and the average was calculated..

Statistical analysis

The obtained data were analyzed by the analysis of variance method (Snedecor and Cochran, 1972) Means were compared using L.S.D. .

RESULTS AND DISCUSSION

Mineral Leaf content :

The mineral content of (N,P,K, Ca and Mg) of the representative leaf samples was determined and calculated as a percent on dry weight basis is shown in Table (2) . Nitrogen and phosphorus were not affected significantly by the level of potassium added at one dose or at two equal doses in both seasons of study .

The values ranged between 1.7-2.0% and 0.17 –0.19% for nitrogen and phosphorus in the two seasons, respectively.

As for potassium content in the leaves, results clearly showed that different potassium treatments tended to increase K content in the leaves comparing with those of the control.

Table (2) Effect of level and number of potassium applications on rogen, phosphorus, Potassium and magnesium content (as percentage of dry matter) in leaves of “ Picual” olive trees In (1997 and 1998 seasons).

Treatments	No. of application	Nitrogen %		Phosphorus %		Potassium %		Calcium %		Magnesium %	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Control		1.6	1.6	0.16	0.17	0.5	0.6	0.80	0.85	0.12	0.11
300 gm potassium sulphata	1	1.7	1.9	0.18	0.18	0.7	0.9	0.90	0.92	0.11	0.12
400 gm potassium sulphata	1	1.9	1.9	0.17	0.18	0.8	1.0	0.85	0.83	0.12	0.13
500 gm potassium sulphata	1	1.8	2.0	0.17	0.18	0.8	1.1	0.80	0.81	0.10	0.11
300 gm potassium sulphata	2	1.8	1.8	0.19	0.17	0.8	1.1	0.94	0.90	0.13	0.14
400 gm potassium sulphata	2	1.9	1.9	0.18	0.18	0.9	1.1	0.86	0.88	0.13	0.12
500 gm potassium sulphata	2	1.8	2.0	0.17	0.18	1.0	1.2	0.85	0.86	0.11	0.11
LSD5%		NS	NS	NS	NS	NS	0.2	NS	NS	NS	NS

In the first season, most potassium treatments raised K content in the leaves from 0.5% in the control up to 1%, this means that potassium treatments enhanced leaf mineral content and raised K content in the leaves to the optimum level.

Similar trend was obtained in the second season. Different treatments increased K content in the leaves significantly than the control except, 300 gm potassium sulphate at one dose

(treatment2) since the increment less significance.

Highest K leaf content was obtained by 500 gm potassium sulphate at two equal doses

(treatment 7) since it was 1.2% .

It is clear from the data presented in Table (2), that calcium and Magnesium contents in the leaves were not affected significantly by the level of the applied potassium. However, calcium percentage tended to slightly decrease as potassium level increased in both seasons of study since it was 0.80 – 0.94 and 0.81-0.92 in the first and second season, respectively.

No clear trend was observed in Magnesium content in the leaves due to different treatments of potassium application.

Similar results were obtained by Nour (1967), Perica *et al* (1994) and Loupassaki et al(1997).

Yield / Tree

Data presented in Table (3) clear that fruit yield as Kg/ tree was affected significantly by different potassium sulphate treatments. The highest fruit yield was obtained by 500 gm potassium sulphate at two equal doses . This was true in both seasons ,since it was 12-8 kg in the first season and 14.9Kg . in the second one, followed by 500 gm potassium sulphate at one dose, since it was 11-8 kg. In the first season and 14.7Kg in the second season, respectively.

Control trees produced the least fruit yield in both seasons, since it was 7.5 Kg. in the first season and 8.9 Kg. in the second one. This means that, potassium sulphate at two equal doses increased fruit yield by about 70.6% and 67.4% in the first and second seasons respectively, comparing with the control trees .

The average fruit yield of the two seasons refer that the treatment of 500 gm potassium sulphate at two equal doses is the promising treatment. This treatment exceed fruit yield significantly comparing with the other treatments.

It could be concluded that the increment in fruit yield obtained by potassium treatments could be mainly due to the positive effect on average fruit weight. These results are in harmony with those obtained by Marcelo et al (1994) and Williams et al. (1996).

Fruit oil content

Data presented in Table (3) show that either the rate of potassium fertilization or the number of applications affected fruit oil content of Picual olive trees. Generally, different treatments tended to give slight but insignificant increase in fruit oil % than those obtained from the control treatment in both seasons. The values of oil content ranged between (36.2 – 38%) and (36.9 – 39%) in the first and second seasons respectively.

These results are in agreement with those obtained by Hatim, 1977 and Marcelo et al 1999.

Table (3) Effect of level and number of potassium applications on fruit yield and fruit oil content of “ Picual olive trees in (1997 and 1998 seasons).

Treatments	No. of application	Yield/ tree Kg.		Average of two seasons	Fruit oil content %		Average of two season.
		1997	1998		1997	1998	
Control		7.5	8.9	8.2	36.2	36.9	36.5
300gm potassium sulphate	1	10.4	13.2	11.8	38.0	39.0	38.5
400gm potassium sulphate at one dose	1	11.1	13.6	12.4	36.5	39.0	37.9
500gm potassium sulphate	1	11.8	14.7	13.3	37.0	37.5	37.3
300gm potassium sulphate	2	11.1	13.1	12.1	37.8	38.6	38.2
400gm potassium sulphate	2	11.7	14.4	13.1	36.3	38.2	36.7
500gm potassium sulphate	2	12.8	14.9	13.9	36.5	38.0	36.7
LSD5%		0.4	0.5	0.7	NS	NS	NS

Fruit Quality:

Physical properties :

Fruit weight and volume:

Data presented in Table (4) show that potassium sulphate fertilization of “ Picual” olive tree tended to increase the average fruit weight and volume than that of control trees However, when comparing tested trees for the K levels, it could be observed that the best K level was that of 500 gm either at one or two doses. This was true in both seasons of the study since it ranged between 4- 5.3 gm as weight and 4.1- 5.2 ml as volume in comparison with 3-3.4 as weight and 3.2-3.4 ml as volume in the control trees. It is obvious from the data in Table (4) that the average weight and volume of olive fruits generally increased in the second season in compared with the first one. It can be explained that the nutritional status of the trees was improved significantly as a result to potassium application in the first season.

The least values for average fruit weight and volume were produced by control trees since it was 3.0 gm in the first season and 3.4 gram in the second one.

While fruit volume were 3.2 ml and 3.4ml in the first and second one, respectively.

Specific gravity was not affected significantly by different treatments in both seasons of this study.

These findings are in accordance with those obtained by Hatim (1977) and Kilany (1979).

Fruit length, width and shape index:

Results in Table(4) show that fruit length and width of "Picual" olives were increased significantly by different treatments in both seasons than those obtained from the control trees.

The highest fruit length and width were produced from treatment of 500 gm. When potassium sulphate added at two equal doses in both seasons since it was 2.6 cm in length and 1.8 in width in the first seasons and 2.7 cm in length and 1.9 cm in width of the second season.

Control trees produced fruits with the least fruit length and width in both seasons of study since it was 2.2 cm and 2.4 cm as fruit length in the first and second season .

Fruit width was 1.5 cm and 1.6 cm in the first and second season respectively. These results are in harmony with those obtained by Kilany (1979).

It could be concluded that the most favorable effect regarding to the average fruit weight, volume, length and width was

obtained by 500 gm potassium sulphate at two equal doses in both seasons.

Shape index was not affected significantly by different treatments in both seasons. The values ranged between 1.33 - 1.47 and 1.37-1.50 in the first and second season, respectively . These results are in harmony with those obtained by Loupass aki *et al* (1993).

Data presented in Table(5) showed that Flesh/ fruit ratio of "Picual" olives was affected significantly by different treatments in both seasons of this study.

The highest flesh / fruit ratio was produced by 500 gm potassium sulphate at two equal doses in both seasons since it was 82.0% and 84.6% in the first and second season respectively. Flesh/Fruit ratio was affected significantly by different treatments in both seasons.

Control trees produced the least flesh/ fruit ratio in the two seasons of study since it was 76.7 and 76.5% in the first and second seasons respectively.

These results are in agreement with those obtained by Nour (1967), Hartman and Popioannou (1971) and Fouad *et al* (1992) .

Seed weight was not affected significantly by different treatments in both seasons of the study. It ranged between 0.7 –0.9 and 0.8 – 0.9 gm in the first and second season, respectively .

Table (5) Effect of level and number of potassium application on flesh/fruit ratio, seed weight and seed dimension of “ Picual” olive trees in 1997 and 1998 seasons.

Treatments	No. of application	Flesh/fruit ratio		Seed weight gram		Seed length cm		Seed diameter cm	
		1997	1998	1997	1998	1997	1998	1997	1998
Control		76.7	76.5	0.7	0.8	1.5	1.7	0.9	0.9
300 gm potassium sulphate	1	80.0	80.2	0.8	0.9	1.5	1.9	0.9	0.8
400gm potassium sulphate	1	72.9	81.6	0.9	0.9	1.7	1.8	0.9	0.9
500gm potassium sulphate	1	81.0	79.6	0.9	0.9	1.8	1.9	0.9	0.9
300gm potassium sulphate	2	78.6	82.6	0.9	0.8	1.6	1.8	0.9	0.9
400gm potassium sulphate	2	80.0	77.4	0.9	0.9	1.8	1.9	0.9	0.9
500gm potassium sulphate	2	82.0	84.6	0.9	0.9	1.6	1.9	0.9	0.9
LSD 5%		2.0	2.3	NS	NS	NS	NS	NS	NS

Seed dimensions (length and diameter) were not affected significantly by the different treatments in the two seasons. It ranged between 1.5 –1.9 cm in length and 0.8 –0.9cm diameter.

These results are in agreement with those of Hassan (1980).

CONCLUSION

From these results it could be concluded that the application of 500 gm potassium sulphate at two equal doses in (April – July) is promising for Picual olive trees grown in Rafah orchard or in similar circumstances .

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تأثير التسميد البوتاسي على المحصول وجودة ثمار الزيتون صنف بيكوال تحت ظروف منطقة رفح.

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أجريت هذه التجربة على أشجار الزيتون المثمرة صنف بيكوال المنزرعة برفح بمحافظة شمال سيناء لمدة موسمين (1998/1997) وقد تضمنت التجربة ثلاث مستويات من سلفات البوتاسيوم (300، 400 و 500 جم سلفات بوتاسيوم/شجرة في السنة) . كل مستوى أضيف دفعة واحدة أو أضيف على دفعتين متساويتين أثناء موسم النمو.

أوضحت النتائج أن أعلى محصول للشجرة وكذا وزن وحجم وطول وقطر للثمرة أمكن الحصول عليه المعاملة بـ 500 جم سلفات بوتاسيوم/شجرة في السنة على دفعتين متساويتين بينما صفات الثمار الأخرى لم تتأثر معنوياً بالمعاملات المختلفة.

Table (4) Effect of level and number of potassium applications on fruit physical characteristic of “ Picual “ olive trees (1997 and 1998 seasons).

Treatment	No.of application	Fruit weight (gram)		Fruit volume (cm)		Specific grafity		Fruit length (cm)		Fruit width (cm)		Shape Index	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Control		3.0	3.4	3.2	3.4	0.93	1.00	2.2	2.4	1.5	1.5	1.47	1.50
300gm potassium sulphata	1	4.0	4.7	4.1	4.5	0.97	1.04	2.3	2.5	1.7	1.8	1.35	1.39
400gm potassium sulphata	1	4.4	4.9	4.2	4.8	1.04	1.02	2.4	2.6	1.8	1.8	1.33	1.44
500gm potassium sulphata	1	4.8	5.3	4.6	5.1	1.04	1.04	2.5	2.6	1.8	1.9	1.38	1.37
300gm potassium sulphata	2	4.2	4.6	4.0	4.5	1.06	1.00	2.5	2.6	1.8	1.8	1.39	1.44
400gm potassium sulphata	2	4.5	5.0	4.4	4.9	1.02	1.02	2.5	2.6	1.8	1.9	1.39	1.37
500gm potassium sulphata	2	5.0	5.4	4.8	5.2	1.04	1.04	2.6	2.7	1.8	1.9	1.44	1.42
LSD5%		0.3	0.3	0.4	0.3	NS	NS	0.1	0.1	0.1	0.1	NS	NS