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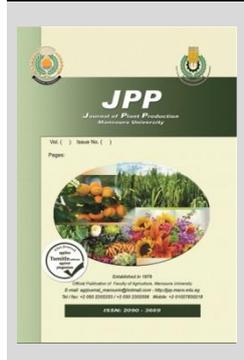
Role of Potassium Fertilization in Improving of Hayani Date Palm Fruiting

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ABSTRACT

This study was run out through 2019 and 2020 seasons at private orchard at Elwakff, Quena Governorate, Egypt to assess the effects of potassium different source fertilizer on the fruiting of Hayani date palm. The experiments were arranged in a completely random design with three replicates one palm each. Results showed that yield/ palm and bunch weight were significantly increased by treated with feldspar, bio (potassium solubilizing bacteria KSB) and potassium citrate. All treatments have a significant increase in the physical and chemical characteristics of the fruits. However, the best results were obtained when using 75% feldspar + 25% bio or 50% feldspar + 50% bio, as well as 1 or 1.5% potassium spraying. No significant differences due to use 75 or 50% feldspar + 25 or 50% bio or potassium citrate 1% or 1.5%. Therefore, from the results of the study, we recommend that treating date palm trees with 50% feldspar + 50% bio or spraying dates with 1% potassium citrate to obtain a high yield with good properties, hence high value marketing.

Keywords: Hayani date palm, potassium, growth, yield, physical and chemical Characters.

INTRODUCTION

Date palm trees (*Phoenix dactylifera* L.) are an old and common fruit tree in many countries worldwide because it could be established in a wide range of soil and environmental conditions. Iraq, Iran, Saudi Arabia, Algeria, Libya and Egypt are the leading countries in date palm cultivation and production (FAO, 2007).

Date palm trees are the most important fruit trees widely grown in different areas over the entire world. They play an important role in social life and economical of the people and considered a characterizing of life in desert in Egypt. It can grow and produce under different soil types from light sandy to heavy clay soil. Also, it has high adaptability to stress conditions as it tolerates high levels of salinity, drought and harsh weather (FAO, 1982 and Jaradat and Zaid, 2004).

In Egypt, total harvested area of dates attained about 49522 ha with total production of 1590414 tons; (FAO, 2017).

Date palm varieties are divided according to moisture content of their fruits into three groups, i.e. soft, semi-dry and dry. Hayani date palm trees cultivar is one of the best soft dates in Egypt has been seen and it has many marketing advantages in either Khalal or Rutab stages. Yield and quality of dates could be depending on cultivar, soil types and agricultural practices.

Fertilization is very important tool and limiting factor to growth, nutritional status and fruiting of fruit corp. Therefore, it is very important practices, that improve the date palm production and fruit quality (Soliman and Osman, 2003; Hussein, 2008; El-Salhy *et al.*, 2008 and El-Salhy *et al.*, 2017). In Egypt, fertilizer consumption per hectare of cultivated area is 10 times more than consumption on average per hectare of the whole world for all nutrients (El-Salhy, 2004).

Potassium (K) is a mobile element in the plant and it is a highly energization of many essential enzymes to respiration, photosynthesis, starches and proteins. It also activities enzymes involved in plant growth and improves fruit quality (Mengel 2001; Ahmed, 2008 and Osman, 2010).

Potassium is an important and essential element for the growth and fruiting of date palm trees, where dates accumulate with a high sugar content about 44-88%, and this depends on the variety, stage of maturity and environmental conditions, (Al-Shahib and Marshall, 2003 and Awad *et al.*, 2011). In fact, K is involved to controll water trees status, photosynthetic stimulating and transferred predigests to fruit and other active sinks (Archer, 1988 and Khayyat *et al.*, 2007).

(Trenkel, 2010 and Solanki *et al.*, 2015) noticed that about 50–90% of applied potassium content fertilizers is not absorbed by plants and lost in the environment, which occasion great economic losses. So, it can be necessary to use and test other fertilization methods to provide important elements for tree growth and productivity, with keeping soil fertility in good condition and environment clean, (Miransari, 2011). Accordingly, foliar application may be a possible alternative for highly mobile nutrients such as, potassium (K) and nitrogen (N) (Mengel, 2001). Al-Hamoudi (2006) treated Barhee date palm trees with (0.4%) potassium sulfate or boric acid at (40 ppm). He found that such treatment significantly improved yield and fruit quality.

Using bio-fertilizers instead of mineral fertilizers marking good use of its advantages (Subba Rao, 1984, Verna, 1990 and El-Salhy, 2004). Therefore, it is preferable to treat with natural fertilizers to reduce the costs of chemical fertilizers and avoid environmental pollution (Furuya, 1995).

Bio-fertilizers are capable to fixation of atmospheric nitrogen, dissolves P & K and mobilize P, Zn, Fe, and Mo to varying degrees. They play an important role to increasing

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soil fertility and helps host plants to resist diseases and stand stress conditions. Bio-fertilizers could improve crop productivity by increasing biological fixation of N, availability and absorb of nutrients and energizing of natural hormones (Kannaiyan, 2002 and El- Sалhy, 2004). Using (KSB) potassium solubilizing bacteria, as bio-fertilizers for agriculture, it can reduce using of the chemical fertilizer and support ecofriendly fruit production (Sindhu et al. 2010).

Using slow release fertilizers appears to be effective in improving the growth and fruiting of most fruit trees. These findings might be due to continuous adjustment of nutrients during all stages of growth and fruit development (Miller et al., 1990; Furuya, 1995; Fageria and Baligar, 2005 and Salem and Ali, 2020).

Feldspar rock contains potassium in ranges from 10 to 13% and used as a slow release fertilizer (Barker et al., 1997 and Abdel-Rahman, 2010).

Previous studies emphasized the beneficial effects of using potassium different fertilizer sources on fruiting of date palms (Ahmed, 2008; El-Sалhy et al., 2008; Harhash and Abdel-Nasser, 2010; Marzouk and Kassem, 2011; Kassem, 2012; Al-Obeed et al., 2013; Ibrahim et al., 2013; Soti et al., 2015; Elamin et al., 2017; El-Sалhy et al., 2017; Omer et al., 2018; Shalan and El-Boray, 2019 and Salem and Ali, 2020).

This study aimed to evaluate the effect of slow release and bio fertilizer on growth and fruiting of Hayani date palms.

MATERIALS AND METHODS

The present study was carried out during 2019 and 2020 growing seasons on Hayani date palm (*Phoenix dactylifera*, L.) grown in a private date palm orchard at Elwakff, Quena Governorate, Egypt. Twelve years old Hayani palms were selected for this study, planted at 10 x 10 meters apart in sandy loam soil. Some physical and chemical properties of the soil were analysed according Widle et al, (1985) and shown in Table 1.

Table 1. Some soil physical and chemical properties.

Property	Value	Property (mg/100g soil)	Value
Sand (%)	78.2	Na+	3.76
Silt (%)	10.2	K+	0.25
Clay (%)	11.6	Ca2+	0.35
Texture	Sandy loam	Mg2+	5.31
Organic matter content,%	0.63	CO3=	-
Calcium carbonate content, % content, %	8.65	HCO3-	2.91
pH	7.43	Cl-	6.80
ECe, dS m-1	1.87	SO4=	9.00

Twenty-one palms as uniform in vigour as possible, were randomly selected for this experiment. The experimental design palms were arranged in a completely randomized design, including 7 treatments and three replicates, one palm pear each.

The treatments were arranged as follows:

- 1- Fertilization with 1000g potassium sulphate (K₂SO₄)/palm(500g K₂O ,Control)
- 2- Fertilization with 100% feldspar (11.5 K₂O) 4.4 kg/palm.
- 3- Fertilization with 75% feldspar 3.3 kg + 25% bio (KBS) 250ml/palm.
- 4- Fertilization with 50% feldspar 2.2 Kg + 50% bio (KBS) 500ml/palm.
- 5- Spraying with 0.5% potassium citrate 5g/L.

6- Spraying with 1% potassium citrate 10g/L.

7- Spraying with 1.5% potassium citrate 15g/L.

All selected palms were fertilized with the recommended dose of 1.2 kg N date palm in three equal doses at (Feb., Apr., and May) as soil broadcast around the trunk. Each palm Phosphate fertilizer 1 kg P₂SO₄/palm was added once during the first week of January with FYM (25 kg/tree). The quantities of potassium sulfate 1000g/tree (K₂SO₄) were broadcasted in around each palm trunk in two equal doses on May and July. Feldspar as slow release added once mid-February. Potassium solubilizing bacteria (KSB), liquid culture of *Bacillus circulans* bacteria, and each palm irrigated with one liter with namely concentration of treatment after irrigation at the two additional, once middle times of February and second on May. Potassium citrate sprayed on bunches at three times; pollination, 4 and 8 weeks after pollination. Sprays were applied by small spraying motor until run-off stage. In addition, soil application with (200 g Fe + 100 g Mn + 100 g Zn) /palm /year for all treatments. The same pollen source was used to pollinate the experimental palms during the two seasons of study.

During both seasons, the following traits were measured:

Yield and yield characteristics:

At the end of khalal stage (harvest time at 15-25 August), the yield/palm (kg), and bunch weight (kg), were recorded.

Physical and chemical characteristics of dates:

After harvest, a sample of thirty fruits was randomly collected from each replicate for determination of physical characteristics of date fruits including: fruits weight, flesh percentage. In addition, fruit length, diameter (cm) and flesh thickness (cm) were also measured.

Chemical characteristics of dates including total soluble solids (TSS %), titratable acidity percentage (TA %) and sugar contents as outlined in A O A C (1985). Five fruits of each sample were washed with distilled water and the flesh was cut into small pieces by clean knife after peeling, then 1g from these pieces was used to determine total tannins (as fresh weight percentage), and soluble tannins were determined in each sample by the method in AOAC, (1985). Total anthocyanin content of fruit skin was determined according to the method by Rabino and Mancinelli, (1986).

The obtained data were subjected to statistical analysis according to the methods described by Snedecor and Cochran (1989). Mean separation was done using Duncan multiple range test at 5 % (Duncan, 1958).

RESULTS AND DISCUSSION

Results

1- Yield characteristics.

Data existed in Table (2) show the effect of potassium sulphate, feldspar, bioform and potassium citrate application on yield and physical characteristics of Hayani date palm during 2019 and 2020 seasons. It is evident from the data that results followed a similar trend over the two studied seasons.

In general view, data indicate that all treatments significantly increased punch weight and yield/ palm compared to control (potassium sulphate) . The obtained punch weight were (18.50, 19.70, 20.11, 19.28, 20.50, 20.68 and 17.26 kg) and yield/palm were(185.0, 197.0, 201.1, 192.8, 205.0, 206.8 and 172.6 kg as an av. of the two studied season) due to treat with feldspar 100%, 75% feldspar + 25% bio,

50% feldspar + 50% bio, 0.5% potassium citrate, 1% potassium citrate, 1.5% potassium citrate and 100% potassium sulphate (control), respectively.

The highest values of punch weight and yield/palm were found on the trees that treated by (50% feldspar + 50% bio T4) and (1.5% potassium citrate T7), punch weight (20.11 and 20.68 kg) and yield/palm (201.1 and 206.8 kg as an av. of the two studied seasons), respectively. On other hand, the lowest values were found on control palms (17.26 kg and 172.6 kg as an av. of the two studied seasons).

Hence, the corresponding increment percentage of yield/palm over control were (7.18, 14.13, 16.51, 11.70, 18.77 and 19.81 %), respectively.

No significant differences due to use 75 or 50% feldspar + 25 or 50% bio as well as spraying potassium citrate 1% or 1.5%. Therefore, from the economic side, it is preferable to treat with 50% feldspar + 50% bio or 1% potassium citrate.

2- Fruit properties.

A- Physical fruit properties:

These physical fruit properties include fruit weight, fruit dimension, flesh percentage and flesh thickness. Data in Tables (2&3) demonstrate that the fruit weight and its dimension took similar trend in response to different

treatments. Results indicate that all treatments significantly increased all the studied physical fruit properties comparative to control. Using (50% feldspar + 50% bioform) and (1.5% potassium citrate) gave the highest values of these traits, where the fruit weight reached (25.30 & 25.87 g), fruit length (5.09 & 5.10 cm), fruit diameter (2.60 & 2.69), flesh percentage (90.92 & 91.03 %) and flesh thickness (0.270 & 0.274 cm as an av. of the two studied seasons), respectively.

The recorded fruit weight were (23.50, 24.77, 25.30, 24.44, 25.69, 25.87 and 21.90 g) and the flesh thickness were (0.258, 0.269, 0.270, 0.260, 0.274, 0.273 and 0.246 cm as an av. of the two studied seasons) due to treat by feldspar 100%, 75% feldspar + 25% bio, 50% feldspar + 50% bio, 0.5% potassium citrate, 1% potassium citrate, 1.5% potassium citrate and 100% potassium sulphate (control), respectively. Hence, corresponding the increment percentage of fruit weight over untreated ones were (7.31, 13.10, 15.52, 11.59, 17.30, and 18.12 %) and flesh thickness were (4.88, 9.35, 9.76, 5.69, 11.38, and 10.97 %), respectively.

No significant differences due to use 75 or 50% feldspar + 25 or 50% bio as well as spraying potassium citrate 1% or 1.5%, therefore, from the economic side, it is preferable to treat with a concentration of 50% feldspar + 50% bio or 1% potassium citrate

Table 2. Effect of feldspar, bio (KBS) and potassium citrate application on punch weight, yield/palm and fruit weight of Hayani date palm trees during 2019 and 2020 seasons.

Treat	Punch weight (kg)			Yield/palm (kg)			Fruit weight (g)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T1- 100% k control	16.53 C	18.00 C	17.26	165.3 C	180.0 C	172.6	21.30 C	22.50 C	21.90
T2- 100% feldspar	17.63 B	19.38 B	18.50	176.3 B	193.8 B	185.0	22.75 B	24.25 B	23.50
T3- 75% feldspar + 25% bio	18.70 A	20.70 A	19.70	187.0 AB	207.0 AB	197.0	24.10 A	25.45 A	24.77
T4- 50% feldspar + 50% bio	19.25 A	20.98 A	20.11	192.5 A	209.8 AB	201.1	24.50 A	26.10 A	25.30
T5- 0.5% potassium citrate	18.22 B	20.35 B	19.28	183.2 B	203.5 B	192.8	23.54 B	25.35 B	24.44
T6- 1% potassium citrate	19.45 A	21.55 A	20.50	194.5 A	215.5 A	205.0	24.68 A	26.71 A	25.69
T7- 1.5% potassium citrate	19.67 A	21.70 A	20.68	196.7 A	217.0 A	206.8	24.89 A	26.85 A	25.87

The values followed by the same letter in the same column do not different significantly at 0.5% probability level...

Table 3. Effect of feldspar, bio (KBS) and potassium citrate application on some physical properties of Hayani dates palm trees during 2019 and 2020 seasons.

treat	Fruit length (cm)			Fruit diameter (cm)			Flesh (%)			Flesh thickness (cm)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T1	4.76 B	4.72 B	4.74	2.43 B	2.40 B	2.41	86.80 B	87.12 B	86.96	0.233 C	0.260 C	0.246
T2	4.98 A	4.93 A	4.95	2.56 A	2.53 A	2.54	89.63 A	89.98 A	89.80	0.243 B	0.274 B	0.258
T3	5.03 A	5.04 A	5.04	2.61 A	2.58 A	2.59	90.68 A	90.90 A	90.79	0.254 A	0.285 A	0.269
T4	5.08 A	5.10 A	5.09	2.60 A	2.59 A	2.60	90.85 A	91.00 A	90.92	0.256 A	0.285 A	0.270
T5	5.04 A	5.06 A	5.05	2.58 A	2.60 A	2.59	90.11 A	90.80 A	90.45	0.244 B	0.276 B	0.260
T6	5.11 A	5.12 A	5.12	2.61 A	2.60 A	2.61	90.15 A	91.16 A	90.65	0.258 A	0.290 A	0.274
T7	5.10 A	5.09 A	5.10	2.63 A	2.61 A	2.62	90.96 A	91.11 A	91.03	0.256 A	0.290 A	0.273

The values followed by the same letter in the same column do not different significantly at 0.5% probability level.

B- Chemical fruit constituents:

Data represented in tables (4 &5) stated that all treatments, significantly improved the fruit chemical constituents in terms of increasing the total soluble solids, sugars content and anthocyanin content and reduction, total acidity percentage and the tannin contents compared to control.

The high values of TSS (39.58 & 40.58 %), total sugar (26.92 & 27.69 %), reducing sugar (16.43 & 16.85 %), non-reducing sugars (10.49 & 10.83 %) and anthocyanin content (18.28 & 19.09 mg/100 g, as an av. of the two studied seasons) were recorded due to treat by (50 or 75% feldspar + 25 or 50% bio) and (1 or 1.5% potassium citrate), respectively. These values were (36.70, 24.37, 14.87, 9.50

and 16.46) due to treat palms with potassium sulphate (control), respectively. Hence, the increment percentage of these traits attained TSS (7.85 & 10.57 %), total sugar (10.46 & 13.62 %), reducing sugar (10.49 & 13.32 %), non-reducing sugars (10.42 & 14.00 %) and anthocyanin content (11.06 & 15.98 %) due to treat with 50 or 75% feldspar + 25 or 50% organic and 1 or 1.5% potassium citrate over (control), respectively. No significant differences due to use 50 or 75% feldspar + 25 or 50% bio and potassium citrate 1% or 1.5%, therefore, it is preferable to treat with a 50 % feldspar + 50% bio and potassium citrate 1%.

Generally, the least values of acidity were (0.24 %) and tannin content (0.173 mg/100 ml g juice as an av. of the

two studied seasons) due to treat by potassium citrate 1.5 %, respectively.

On other hand, the high values of acidity (0.34 %) and tannins content (0.239 mg/100 ml as an av. of the two studied seasons) were recorded on checked due to palms. Hence, the corresponding decrement percentage of these traits attained (29.41 %) and (27.62 %), respectively.

Moreover, the data indicated that there were no significant differences in these studied traits due to apply via

any concentration of studied materials when compared to them.

No significant differences due to use 75 or 50% feldspar + 25 or 50% bio as well as spraying potassium citrate 1% or 1.5%, Therefore, from the economic side , it is preferable to treat with a concentration of 50% feldspar + 50% bio or 1% potassium citrate.

Table 4. Effect of feldspar, bio and potassium citrate application TSS and total sugar content, of Hayani date palm trees during 2019 and 2020 seasons.

treat	TSS (%)			Total sugar (%)			Reducing sugar (%)			Non reducing sugar (%)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
T1	35.33 C	36.70 C	36.01	24.65 C	24.10 D	24.37	14.42 C	15.33 C	14.87	10.23 C	8.77 D	9.50
T2	37.98 B	39.25 B	38.61	26.48 B	25.91 C	26.19	15.46 B	16.46 B	15.96	11.00 B	9.45 C	10.22
T3	39.10 AB	39.90 B	39.50	27.32 AB	26.47 BC	26.89	15.9 AB	16.75 B	16.32	11.32 A	9.72 BC	10.52
T4	39.00 AB	40.16 B	39.58	27.30 AB	26.55 BC	26.92	15.98 A	16.89AB	16.43	11.32 A	9.66 BC	10.49
T5	38.10 B	40.72 AB	39.41	26.58 B	26.90 B	26.74	15.49 B	17.05 A	16.27	11.09 AB	9.85 B	10.47
T6	39.55 A	41.42 A	40.58	27.70 A	27.68 A	27.69	16.33 A	17.38 A	16.85	11.37 A	10.30A	10.83
T7	39.30 A	41.18 A	40.24	27.55 A	27.76 A	27.65	16.16 A	17.44 A	16.80	11.39 A	10.32A	10.85

The values followed by the same letter in the same column do not different significantly at 0.5% probability level.

Table 5. Effect of feldspar, organic and potassium citrate application on acidity% and tannins and anthocyanin contents of Hayani date palm trees during 2019 and 2020 seasons.

Treat	Acidity (%)			Tannins (%)			Anthocyanin (%)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
1- 100% k control	0.33 A	0.35 A	0.34	0.258 A	0.221 A	0.239	17.23 D	15.70 C	16.46
2- 100% feldspar	0.28 B	0.29 B	0.28	0.221 B	0.191 B	0.206	18.53 C	16.98 B	17.75
3- 75% feldspar + 25% bio	0.26 C	0.27 C	0.26	0.201 C	0.173 C	0.187	18.95 BC	17.22 B	18.08
4- 50% feldspar + 50% bio	0.25 C	0.26 C	0.25	0.195 C	0.170 D	0.182	19.25 B	17.31 B	18.28
5- 0.5% potassium citrate	0.27 B	0.28 B	0.27	0.213 B	0.180 C	0.195	18.58 C	17.56 B	18.07
6- 1% potassium citrate	0.23 D	0.25 D	0.24	0.186 D	0.160 E	0.173	19.63 A	18.55 A	19.09
7- 1.5% potassium citrate	0.23 D	0.25 D	0.24	0.180 D	0.162 E	0.171	19.78 A	18.41 A	19.09

The values followed by the same letter in the same column do not different significantly at 0.5% probability level.

Discussion

Potassium is an important and essential element for the growth and fruiting of date palm trees, where dates accumulate with a high sugar content of about 44-88%, and this depends on the variety, stage of maturity and environmental conditions, (Al-Shahib and Marshall, 2003 and Awad et al., 2011). Potassium is an important element 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).

Foliar application may be a possible alternative for highly mobile nutrient such as, potassium (K) and nitrogen (N) (Mengel, 2001).

Treated Barhee date palm trees with (0.4%) potassium sulfate which to a significant increase in fruiting properties (Al-Hamoudi, 2006).

The feldspar as a slow release-K gave a significant advantage if the release continues over many years. The residual material after release of potassium and other nutrients easily gets soil fertility. Nutrients from feldspar release at a rate that allows them to remain in the soil top to be used by plants. The feldspar effects due to its role as a potassium source which it activates a lot of physiological process as occur in plant such as maintaining cell organization, cell hydration and permeability. It activates many enzymes system such that occur in protein synthesis and formation of carbohydrates (Nijjar, 1985; and Abdel-Rahman, 2010).

The great benefits of biofertilizers on fruiting of date palm trees were attributed to their positive action on enhancing microflora activity, soil fertility, and availability of all nutrients (Kannaiyan, 2002).

Potassium solubilizing bacteria (KSB) dissolve K from dissolve K-bearing minerals such as mica, illite, and orthoclase, by secreting organic acids, which either directly dissolved rock potassium or chelated silicon ions to bring potassium into the solution. (Sindhu et al. 2010).

From our results, use 50% feldspar + 50% bio or 1% potassium citrate increased yield percentage by (16.51 & 18.77 %), fruit wight (15.52 & 17.30 %), TSS (9.91 & 12.69 %) and anthocyanin (11.06 & 15.98 %) respectively, and decreased tannins percentage by (23.84 & 27.62 %), this increases the marketing value and quality of the fruits.

The promotive effect of different potassium fertilizer sources on fruiting of date palm trees were emphasized by (Bamiftah, 2000; Soliman and Osman, 2003; Ahmed, 2008; Osman, 2010; Elamin et al., 2017; El-Salhy et al., 2017; Omer et al., 2018; Shalan and El-Boray, 2019 and Salem and Ali, 2020). They concluded that using different forms of potassium fertilization had a positive effect on yield and fruit quality of date palm cultivars.

CONCLUSION

Generally, it is concluded that using feldspar as natural potassium source in combined KSB (50% feldspar + 50% bioform KSB or spraying dates with 1%potassium citrate) to improve fruiting of Hayani date palms and to increase the marketing value.

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دور التسميد البوتاسي في تحسين اثمار نخيل البلح الحياتي

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تم اجراء هذه التجربه خلال موسمين متتاليين 2019 و 2020 في مزرعه خاصه بمنطقة الوقف بمحافظة قنا ، مصر لدراسة تأثير المصادر المختلفه للأسمدة البوتاسيه على اثمار نخيل البلح الحياتي. أوضحت النتائج حدوث زياده معنويه في المحصول وزن السوياطه وذلك عند المعامله بالفلسبار والحيوي (KSB) ورش سترات بوتاسيوم. جميع المعاملات أدت الي حدوث زياده معنويه في الخصائص الطبيعيه والكيميائية للثمار. وكانت أفضل النتائج المتحصل عليها عند المعامله بـ 75% فلسبار + 25% حيوي أو 50% فلسبار + 50% حيوي و 1% أو 1.5% سترات بوتاسيوم. لا توجد فروق معنويه عند استخدام (75 أو 50% فلسبار + 25 أو 50% حيوي) وكذلك (سترات بوتاسيوم 1% أو 1.5%)، لذلك يفضل من الناحيه الاقتصاديه معاملة الأشجار بتركيز 50% فلسبار + 50% حيوي او 1% سترات بوتاسيوم. من نتائج الدراسة نوصي بمعاملة أشجار نخيل البلح الحياتي بنسبة 50% فلسبار + 50% حيوي او 1% سترات بوتاسيوم وذلك للحصول على محصول عال ذو خصائص طبيعيه وكيميائيه جيده وذلك لزيادة القدره التنافسيه في الأسواق والحصول علي عائد اقتصادي عالي.