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RESPONSE OF SOME MELON CULTIVARS TO POTASSIUM FERTILIZATION RATE AND ITS EFFECT ON PRODUCTIVITY AND FRUIT QUALITY UNDER DESERT CONDITIONS

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ABSTRACT

This investigation was carried out at Wadi El-Natrown Farm, Agric. Res. Station, Fac. Agric., Cairo University, Beheira Governorate, Egypt, during 2012 and 2013 autumn seasons. Two cultivars viz., Visa (Galia type) and Magenta (Charantais type) were used in this study under three treatments rates of potassium, viz., 100, 150 and 200 kg/fed. There were significant differences between treatments for the measured traits. The treatment of 150 and 200 kg/fed. had the best results for the measured vegetative growth, number of fruits per plant, fruit weight per plant, and the highest crop yield for both cultivars.
Keyword: Melon, potassium fertilization, yield, quality.

INTRODUCTION

Melon (*Cucumis melo* L.) belongs to the Cucurbitaceae family, which includes several other important vegetables. The cultivated area of melon in Egypt is 952392 feddan and the average yield per/feddan is 11.3 ton. (Ministry of Agric, Egypt, 2013).

Potassium is well recognized as the essential plant nutrient with the strongest influence on many quality parameters of fruits and vegetables. Plants obtain Potassium (K) primarily from the soil in the form of K^+ Potassium uptake is regulated by several factors including texture, moisture conditions, pH, aeration, and temperature (Mengel and Kirkby, 1980; Tisdale *et al*., 1985).Plant developmental stage influences the capacity for K uptake. More K is taken up during vegetative growth stages when roots are more active than in reproductive growth stages (Beringer*et al*., 1986). Developing fruits are stronger sinks for photoassimilates than roots and other vegetative tissues. This competition for photoassimilates reduces root growth and energy supply for nutrient uptake including K (Marschner, 1995). Therefore, during reproductive development, soil K supply is seldom adequate to support crucial processes such as sugar transport from leaves to fruit, enzyme activation, protein synthesis, and cell extension that ultimately determine fruit yield and quality. Previous research has demonstrated that this apparent K deficiency during fruit development and maturation can be mitigated through supplemental foliar K applications to netted muskmelon (Lester *et al*., 2005).

Enhancing effect of potassium on plant growth may be due to fact that potassium has essential functions in osmoregulation, enzyme activation, regulation of cellular pH, cellular cation-anion balance, regulation of transportation by stomata and the transport of assimilates (Taiz and Zeiger, 1998).

Insufficient or excessive potassium level adversely affects fruit quality, while adequate K nutrition is associated with increased yields, fruit size, increased soluble solids and ascorbic acid concentrations, improved fruit color, increased shelf life, and shipping quality of many horticultural crops(Asri and Sonmez, 2010;Lester *et al*., 2006).

Plant growth, Fruit weight, fruit diameter, total yield, flesh firmness and the number of marketable fruits significantly increased with increasing of K_2O doses (Demiral and Koseoglu, 2005; Frizzone *et al.,* 2005; Kaya *et al.,* 2007).

Jiofon and Lester (2011) evaluate the impact of foliar K on cantaloupe yield and quality in calcareous soils testing high in K, and whether differences exist among K sources for foliar feeding. Foliar K treatments resulted in higher plant tissue K concentrations, higher soluble solids concentrations, total sugars, and bioactive compounds (ascorbic acid and β-carotene). Among the different K salts, KNO_3 consistently resulted in non-significant effects on fruit quality compared to control treatments.

Tang *et al.* (2012) evaluated effects of potassium levels on fruit quality in two Hami melon cultivars, 'Flavor No.4' and 'Xuelihong' in soilless medium culture under a plastic greenhouse. Four potassium (K) levels, K0 (control), K1 (insufficient), K2 (suitable), and K3 (excessive) in nutrient solution, which represent 0, 117, 234, and 351 mg/L of potassium, respectively, were applied. Results revealed that at potassium level of 234-351 mg/L, the concentrations of total soluble solids, sucrose, K content, and volatile acetate components significantly increased in fruit flesh, which should improve the taste and aroma of melon. Favorable quality of melon in soilless culture was achieved when potassium level was adjusted to near 234 mg/L in nutrient solution.

Asao *et al.* (2013) investigated the impact of reduced K concentrations in nutrient solution on plant growth, yield and melon fruit qualities. Plant growth variables were not decreased greatly except root dry weights in nutrient solution with reduced KNO_3. They found that it had not any significant effect on fruit yield. Soluble solid content of melon fruits were not decreased in plants grown with reduced KNO_3concentra-tion compared with standard nutrient solution.

The aim of this study was to investigate the response of some melon cultivars to potassium fertilization rates under desert conditions and their effects on vegetative growth parameters, productivity and fruit quality.

MATERIALS AND METHODS

Experimental site: This study was carried out at Wadi El-Natrown Farm, Agric. Res. Station, Fac. Agric., Cairo University, Beheira Governorate, Egypt, during the two successive autumn seasons of 2012 and 2013.

Plant materials: Seeds of cv. Visa (Galia type) were obtained from Agrimatco Company and orange flesh melon F_1 hybrid cv. Magenta (Charantais type) were obtained from Nunhems Company. The nursery was sown using foam seedling trays (84 cells) which were filled with a mixture of peat moss: vermiculite (1:1 V/V) on 1st of August in both seasons. The seedlings were transplanted in the field on 25th of August in both seasons on the center of the bed.

Potassium rates treatments: Drip irrigation method was used and potassium fertilization rates treatments were 100, 150 and 200 kg/fed. as potassium sulfate during soil preparation before sowing.

Experimental design: The experimental design was a split-plot using the cultivars in the main plot, while potassium fertilization rates were in the sub-plot with three replicates. The area of each experimental plot was 24 m^2 (20 m length × 1.20 m width). Each plot included 40 plants, with space of 50 cm between hills within the row.

The normal cultural practices needed for growing melon plants, *i.e.* N and P fertilization and pest control were practiced as commonly required.

Data recorded

The following data were recorded on the melon plants

1. **Vegetative growth parameters:** The vegetative growth measurements were recorded twice at 30 and 75 days after transplanting (DAT) without pulling plants. Three plants were randomly taken from each plot for measuring stem length, plant fresh and dry weight at 30 and 75 days after transplanting (DAT) during the growing season.
2. **Fruit characters:** Fruit length, fruit diameter and fruit shape index were recorded on 5 fruits per plot.
3. **Yield and its components:** Average fruit weight (AFW), number of fruits per plant, yield/plant and yield per feddan were recorded at the end of seasons.
4. **Statistical Analysis:** Data were statistically analyzed using MSTAT-C v. 2.1 (Michigan State University, Michigan, USA) and mean comparisons were based on the least significant difference (LSD) test (Maxwell and Delaney, 1989).

RESULTS AND DISCUSSION

1. Effect of potassium rate on vegetative growth parameters:-

a. Stem length

The influence of different potassium rates on stem length at 30 and 75 days from transplanting are presented in Tables 1 and 2in both seasons. Data indicated that there were significant differences among treatments on this character during the two studied seasons.

Data in Tables 1 and 2 clearly indicate that fertilizing melon plant with 150 kg and 200 kg potassium sulfate/fed. had a significant effect on stem length after 30 days and 75 days from transplanting (DAT) in both seasons.

Data in Table 1 show that fertilizing cv. Magenta plants with treatment 200kg potassium sulfate/fed. had a significant effect on stem length after 30 DAT in 2012 season while in season 2013 fertilizing cv. Visa plants with treatment 200kg potassium sulfate/fed. had a significant effect on stem length after 30 DAT in Table2. While after 75 DAT all treatments had a significant influence on stem length with cv. Magenta Plants in both seasons.

Enhancing effect of potassium on plants growth may be due to fact that potassium has essential functions in osmoregulation, enzyme activation, regulation of cellular pH, cellular cation-anion balance, regulation of transportation by stomata and the transport of assimilates (Taiz and Zeiger, 1998).These results are in agreement with Kaya *et al.* (2007) and Asao *et al.* (2013) they reported that melon cultivars differed in their fertilizes requirements.

b. Plant fresh weight

Data recorded in Tables 1 and 2 show the effect of potassium fertilizer rate on plant fresh weight at 30 and 75 DAT during the two seasons. There were significant differences between melons cvs for plant fresh weight at 30 and 75 DAT during the two seasons of growth. Data in Tables 1 and 2 clearly indicate that fertilizing cv. Magenta plants with 150 kg potassium sulfate/fed. and 200 kg potassium sulfate/fed. significantly stimulated plant fresh weight at 30 and 75 DAT during the two seasons of growth.

c. Plant dry weight

Data presented in Tables 1 and 2 show the effect of potassium fertilizer rate on plant dry weight at 30 and 75 days from transplanting during the two seasons of growth.

Table1.Effect of potassium sulfate rates on stem length, fresh and dry weight of melon cv. Magenta and Visa during 2012 season.

treatments	Stem length(cm)		Plant fresh weight(g)		Plant dry weight(g)	
Cvs	30 DAT	75 DAT)	30 DAT	75 DAT	30 DAT	75 DAT
Magenta (C1)	174.1	282.58 a	342.98 a	576.78 a	56.11 a	95.24 a
Visa (C2)	168.48	253.5 b	292.3 b	532.8 b	38.48 b	90.84 b
LSD $_{0.05}$	NS	8.42	26.61	11.69	3.74	4.22
potassium sulfate rates						
100kg (T1)	163.6 b	252.9 b	294.3 b	527.8 b	42.60 c	87.53 b
150kg (T2)	172.3 a	281.6 a	335.1 a	576.2 a	48.48 b	95.38 a
200kg (T3)	178.0 a	269.6 ab	323.5 ab	560.3 a	50.80 a	96.22 a
LSD $_{0.05}$	7.56	18.33	29.51	17.92	2.31	2.67
The interaction						
C1 × T1	163.6 b	271.5 ab	314.8 bc	564.4 a-c	50.63 c	90.20 c
C1 × T2	173.4 b	295.3 a	354.8 ab	589.3 a	56.93 b	95.47 b
C1 × T3	185.3 a	281.0 ab	359.3 a	576.6 ab	60.77 a	100.1 a
C2 × T1	163.7 b	234.3 c	273.8 c	491.2 d	34.57 e	84.87 d
C2 × T2	171.0 b	267.9 b	315.3 bc	563.1 bc	40.03 d	95.30 b
C2 × T3	170.8 b	258.3 bc	287.8 c	544.0 c	40.83 d	92.37 bc
LSD $_{0.05}$	10.69	25.92	41.73	25.34	3.27	3.78

Data clearly indicate that fertilization melon plants with 150 kg and 200 kg potassium sulfate/fed. had a significant influence on melon plant dry weight after 30 days and 75 DAT during 2012 and 2013 seasons. Magenta plants treated by 200kg potassium sulfate/fed. had a significant effect on plant dry weight after 30 and 75 DAT in 2012 season while in Table2, both cultivars plants treated with 150 kg and 200kg potassium sulfate/fed. had a significant effect on plant dry weight after 30 DAT in season 2013but after 75 DAT in most treatments no had been detected significant effects on plant dry weight in 2013 season.

These results are in agreement with Kaya *et al.* (2007)and Asao *et al.* (2013), they reported that potassium fertilization gave rise to an increase in the vegetative growth parameters.

Table 2.Effect of potassium sulfate rates on stem length, fresh and dry weightof melon cv. Magenta and Visa during 2013 season.

treatments	Stem length(cm)		Plant fresh weight(g)		Plant dry weight(g)	
Cvs	30 DAT	75 DAT)	30 DAT	75 DAT	30 DAT	75 DAT
Magenta (C1)	194.3	307.67 a	404.9 a	580.08 a	56.50	112.70 a
Visa (C2)	202.3	260.97 b	370.9 b	543.9 b	54.58	104.64 b
LSD $_{0.05}$	NS	7.18	7.98	7.00	NS	1.84
potassium sulfate rates						
100 kg (T1)	188.7 b	277.5 b	350.9 c	545.0 b	47.78 c	99.97 b
150 kg (T2)	197.3 ab	281.2 ab	393.6 b	577.7 a	57.18 b	112.6 a
200 kg (T3)	208.9 a	294.2 a	419.1 a	563.3 ab	61.65 a	113.4 a
LSD $_{0.05}$	13.47	13.32	15.54	19.11	4.08	7.75
The interaction						
C1 × T1	185.4 c	305.6 a	397.2 bc	573.8 ab	52.20 c	107.3 a
C1 × T2	191.4 bc	307.4 a	395.3bc	597.0 a	55.93 bc	116.3 a
C1 × T3	206.2 ab	310.0 a	422.2 a	569.4 b	61.37 ab	114.5 a
C2 × T1	192.0 bc	249.4c	304.7 d	516.2 c	43.37 d	92.60 b
C2 × T2	203.2 a-c	255.0 c	392.0 c	558.3 b	58.43 ab	108.9 a
C2 × T3	211.6 a	278.4 b	416.1 ab	557.3 b	61.93 a	112.4 a
LSD $_{0.05}$	19.05	18.83	21.98	27.03	5.77	10.97

2. Effect of potassium fertilizer rateson physical characters of fruit

a. Fruit length:

Data presented in Tables 3 and 4 include the effect of potassium sulfate rates on melon fruit length.

As for fruit length of melon cultivars, cv. Magenta showed a significantly higher on fruit length, in both seasons,(11.61 cm and 13 cm/fruit) in the first and second seasons, respectively, compared with cv. Visa (10.6 cm and 10.62 cm/fruit) in the first and second seasons, respectively.

Data indicated that there is no significant effect among the three treatments of potassium sulfate rates on fruit length, in both seasons.

The interaction between cv Magenta. with all treatments of potassium sulfate had a significant effect on fruit length in both seasons but the interaction between cv. Visa with 100 kg potassium sulfate/fed. had a significant effect on fruit length in the first season only.

b. Fruit diameter:

Regarding tofruit diameter of melon cultivars data presented in Tables 3 and 4. indicated that there is no significant influence among cultivars in the first season but the higher fruit diameter was recorded by cv. Magenta during the second season.

Data in Table3 show that the application with potassium sulfate rate had no significant effect on fruit diameter in the first season but the plants which fertilized by all rates of potassium sulfate except 150 kg potassium sulfate/fed. gave the higher fruit diameter in the second season.

The interaction between both cultivars and potassium sulfate rate, data in Tables 3 and 4 show that the highest values of fruit diameter were recorded with cv Magenta. under all treatments of potassium sulfate in both seasons and cv. Visa with 100 kg potassium sulfate/fed. in the first season only.

These results are in agreement with those obtained by Demiral and Koseoglu (2005), Frizzone *et al.* (2005), Lester *et al.* (2005), Kaya *et al.* (2007), Tang *et al.* (2012) and Asao *et al.* (2013) on melon, they found that the highest values of fruit diameter and fruit length were obtained with the highest potassium application levels.

c. Fruit shape index:

Data presented in Tables 3 and 4 indicate insignificant effect among cultivars and all fertilization treatments on fruit shape index in both seasons of growth.

Table3.Effect of potassium sulfate fertilizer rates on physical characters of fruit of melon cv. Magenta and Visa during 2012 season.

Treatment	**Fruit length (cm)**	**Fruit diameter (cm)**	**Fruit shape index**
Cultivar			
Magenta (C1)	11.61 a	11.42	1.02
Visa (C2)	10.6 b	10.48	1.01
LSD $_{0.05}$	0.85	NS	NS
potassium sulfate rates			
100 kg (T1)	11.3	11.32	1.00
150 kg (T2)	10.9	10.67	1.02
200 kg (T3)	11.12	10.87	1.02
LSD $_{0.05}$	NS	NS	NS
The interaction			
C1 × T1	11.43 ab	11.47 ab	1.00
C1 × T2	11.43 ab	11.17 ab	1.03
C1 × T3	11.97 a	11.63 a	1.03
C2 × T1	11.17 ab	11.17 ab	1.00
C2 × T2	10.37 b	10.17 b	1.02
C2 × T3	10.27 b	10.10 b	1.02
LSD $_{0.05}$	1.45	1.42	NS

Table 4.Effect of potassium sulfate fertilizer rates on physical characters of fruit of melon cv. Magenta and Visa during 2013 season.

Treatment Cultivar	Fruit length (cm)	Fruit diameter (cm)	Fruit shape index
Magenta (C1)	13.00 a	12.53 a	1.04
Visa (C2)	10.62 b	10.58 b	1.01
$LSD_{0.05}$	0.41	0.35	NS
potassium sulfate rates			
100 kg (T1)	12.03	11.97 a	1.00
150 kg (T2)	11.47	10.97 b	1.05
200 kg (T3)	11.93	11.73 ab	1.02
$LSD_{0.05}$	NS	0.89	NS
The interaction			
C1 × T1	13.47 a	12.97 a	1.04 a
C1 × T2	13.00 a	12.37 ab	1.05 a
C1 × T3	12.53 ab	12.27 ab	1.02 ab
C2 × T1	10.60 cd	10.97 c	0.97 b
C2 × T2	9.93 d	9.57 d	1.04 a
C2 × T3	11.33 bc	11.20 bc	1.02 ab
$LSD_{0.05}$	1.38	1.26	0.06

3. Effect of potassium fertilizer rates on yield and its components

a. Number of fruits per plant:

Data presented in Tables 5 and 6 show the effect of potassium sulfate rates on number of fruit per plant of melon.

Magenta cv. showed a significantly lower as for number of fruits per plant, in both seasons, than cv. Visa.

Data indicated that there were significant differences among the three treatments of potassium sulfate rates on number of fruits per plant, in both seasons. In this regard, the lowest number of fruits per plant was observed with 150 kg potassium sulfate/fed. (8.5 and 8.67 fruit per plant) in the first and second seasons, respectively.

Data in Tables 5 and 6 show the interaction between melon cvs and potassium sulfate rates. The interaction between cv. Visa with 150 kg potassium sulfate/fed. had a higher significant on number of fruits per plant in the first season (Table5), the interaction between both cultivars with150 kg potassium sulfate/fed. had a significant effect on number of fruits per plant in the second season.

Table5.Effect of potassium sulfate rates on yield and its components of melon cv. Magenta and Visa during 2012 season.

Treatments Cvs	No. of fruits per plant	Average fruit weight(g)	Yield / plant(kg)	Yield / fed (ton)
Magenta (C1)	7.33 b	721.19 a	5.28 a	26.41 a
Visa (C2)	8.33 a	523.3 b	4.36 b	21.80 b
LSD $_{0.05}$	0.01	3.27	0.02	0.12
potassium sulfate rates				
100 kg (T1)	7.16 c	607.8 c	4.34 c	21.71 c
150 kg (T2)	8.50 a	623.9 b	5.27 a	26.33 a
200 kg (T3)	7.84 b	635.1 a	4.86 b	24.28 b
LSD $_{0.05}$	0.01	4.45	0.03	0.17
The interaction				
C1 × T1	7.00 e	684.8 c	4.80 d	23.97 d
C1 × T2	8.00 c	699.6 b	5.60 a	28.00 a
C1 × T3	7.00 e	779.1 a	5.45 b	27.27 b
C2 × T1	7.33 d	530.8 e	3.89 f	19.45 f
C2 × T2	9.00 a	548.1 d	4.93 c	24.67 c
C2 × T3	8.67 b	491.0 f	4.26 e	21.29 e
LSD $_{0.05}$	0.01	6.29	0.05	0.23

Table6.Effect of potassium sulfate rates on yield and its components of melon cv. Magenta and Visa during 2013 season.

Treatments Cvs	No. of fruits per plant	Average fruit weight(g)	Yield / plant(kg)	Yield / fed (ton)
Magenta (C1)	8.11 b	881.24 a	7.15 a	35.74 a
Visa (C2)	8.23 a	495.0 b	4.07 b	20.35 b
LSD $_{0.05}$	0.01	6.29	0.05	0.27
potassium sulfate rates				
100 kg (T1)	7.67 c	666.8 c	5.11 b	25.57 b
150 kg (T2)	8.67 a	676.9 b	5.87 a	29.34 a
200 kg (T3)	8.17 b	720.6 a	5.85 a	29.24 a
LSD $_{0.05}$	0.01	6.71	0.06	0.23
The interaction				
C1 × T1	7.67 d	852.5 b	6.54 b	32.69 b
C1 × T2	8.67 a	861.1 b	7.47 a	37.33 a
C1 × T3	8.00 c	930.1 a	7.44 a	37.21 a
C2 × T1	7.67 d	481.1 e	3.69 d	18.45 d
C2 × T2	8.67 a	492.7 d	4.27 c	21.36 c
C2 × T3	8.33 b	511.0 c	4.26 c	21.28 c
LSD $_{0.05}$	0.01	9.49	0.08	0.41

b. Average fruit weight:

Data given in Tables 5 and 6 indicated significant differences among cultivars on this character during the two studied seasons. The higher average fruit weight was recorded by cv. Magenta during the two seasons (721.9 g and 881.24 g/fruit) in the first and second seasons, respectively.

Data also show that the plants which fertilized by 200 kg potassium sulfate/fed. gave the higher average fruit weight compared with the other treatments in both seasons.

The interaction between both cultivars and potassium sulfate rate, (Tables 5 and 6) show that the highest values of average fruit weight were recorded with cv. Magenta under 200 kg potassium sulfate /fed. in both seasons.

These results are in agreement with Demiral and Koseoglu (2005), Frizzone *et al.* (2005), Kaya *et al.* (2007) and Asao *et al.* (2013 on melon, they found that the highest values of fruit diameter and fruit length were obtained with the highest potassium application levels

c. Yield per plant and total yield per fed:

Data presented in Tables5 and 6 indicate that the higher values of yield /plant and yield/fed. were produced with cv. Magenta in both seasons of growth**.**

Data in Table5 show that the highest values of yield/plant and yield per/fed. were recorded when plants fertilized by 150 kg potassium sulfate /fed. in the first season and fertilized by 150 kg and 200 kg potassium sulfate /fed. in the second season. But the lowest values of yield/plant and yield/fed were recorded with those plants fertilized by 100 kg and 200 Kg potassium sulfate /fed. in the first season and with 100Kg potassium sulfate /fed. in the second season

Concerning to the effect of the interaction between cultivars and potassium sulfate rate, data in Tables 5 and 6 show that the highest yield/plant and yield /fed. were recorded by cv. Magenta with 150 kg potassium sulfate /fed. in both seasons and by cv. Magenta with 200 kg potassium sulfate /fed. in the second season.

These results are in agreement with Demiral and Koseoglu (2005), Frizzone*et al.* (2005), Kaya *et al.* (2007) and Asao *et al.* (2013) on melon, they found that the highest values of fruit diameter, fruit length, number of fruits per plant and number of fruit per feddan were obtained with the highest potassium application levels.

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استجابة بعض اصناف القاوون لمعدلات التسميد البوتاسى وتأثيرها على الانتاجية و صفات الجودة تحت الظروف الصحراوية

مرغنى محمد مرغنى ، ياسر محمد أحمد ، محمد كامل فتح الله الطواشى.
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اجريت هذه الدراسة لدراسة إستجابة صنفى القاوون هجين فيزا (طراز الجاليا) و هجين ماجنتا (طراز الشارانتية) لمعدلات التسميد البوتاسى تحت الظروف الصحراوية وتأثيرها على صفات النمو الخضري والإنتاجية والجودة، وقد أجريت هذه الدراسة فى مزرعة وادى النطرون – محطة التجارب الزراعية – كلية الزراعة – جامعة القاهرة – بمحافظة البحيرة – جمهورية مصر العربية و ذلك فى الموسم الخريف لعامى ٢٠١٢ و ٢٠١٣. تم إستخدام ٣ معدلات للتسميد البوتاسى ١٠٠، و ١٥٠ ، و ٢٠٠ كجم / فدان. اظهرت النتائج أن المعدلات١٥٠ ، و ٢٠٠ كجم / فدان قد أعطت أفضل نتائج للنمو الخضرى لكلا الصنفين خلال الموسمين. و كذلك اوضحت النتائج عدم وجود فروق معنوية بين المعدلات١٥٠ ، و ٢٠٠ كجم / فدان و أعطى كلا المعدلين أعلى عدد للثمار و وزن للثمار / نبات و أعلى محصول بالمقارنة بمعدل ١٠٠ كجم / فدان.