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استجابة بعض أصناف البطاطا لطرق ومعدلات إضافة البوتاسيوم تحت ظروف الأرض الرملية

٢- المحصول وكفاءة استخدام البوتاسيوم وجودة الجذور المتدرنة والقدرة التخزينية

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الملخص العربي

أجرى هذا البحث خلال الموسمين الصيفين المتتاليين لعامي ٢٠٠٨ ، ٢٠٠٩ فى مزرعة محطة بحوث البساتين بالقصاصين، بمحافظة الاسماعلية ويهدف الى دراسة استجابة نبات البطاطا لطريقة ومعدل إضافة البوتاسيوم (إضافة أرضية وإضافة عن طريق الرش) على المحصول وكفاءة استخدام البوتاسيوم وجودة الجذور المتدرنة والقدرة التخزينية لبعض أصناف البطاطا (بيوروجارد وأبيس) تحت ظروف الأرض الرملية وباستخدام نظام الري بالتنقيط.

ويمكن إيجاز أهم النتائج المتحصل عليها فيما يلي :

(١) سجل الصنف بيوروجارد أعلى القيم للعدد الجذور المتدرنة ومحصول النبات ،والمحصول القابل للتسويق والمحصول الكلى للفدان، وكفاءة استخدام البوتاسيوم وكذلك محتوى الجذور من النشا، بينما سجل الصنف أبيس أعلى القيم للسكريات الكلية ونسبة المواد الصلبة الكلية ومحتوى الجذور من الكاروتين، وكذلك النسبة المئوية للفقد في الوزن والتلف أثناء تخزين الجذور.

(٢) أعطى تسميد البطاطا في الأرض الرملية بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% أعلى القيم لعدد الجذور المتدرنة

ومحصول النبات ومتوسط وزن الجزر والمحصول القابل للتسويق والمحصول الكلى للفدان وكفاءة استخدام البوتاسيوم وكذلك محتوى الجذور من النيتروجين والفوسفور والبوتاسيوم والنشا (%) والسكريات الكلية ونسبة المواد الصلبة الذائبة والكاروتين، وقد سجلت هذه المعاملة أيضا اقل القيم للنسبة المئوية للفقد في الوزن والتلف أثناء تخزين الجذور .

(٣) كانت أفضل معاملة تفاعل عند تسميد الصنف بيوروجارد بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% والتى أعطت أكبر زيادة في كل من المحصول القابل للتسويق والمحصول الكلى للفدان وكفاءة استخدام البوتاسيوم والقدرة التخزينية للجذور .

RESPONSE OF SOME SWEET POTATO CULTIVARS TO METHODS AND RATES OF POTASSIUM APPLICATION UNDER SANDY SOIL CONDITIONS

2- YIELD, POTASSIUM USE EFFICIENCY, TUBER ROOT QUALITY AND STORABILITY

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ABSTRACT: ***This work was carried out during the two successive summer seasons of 2008 and 2009 under sandy soil conditions using drip irrigation system at Horticultural Research Station, Ismailia Governorate to study the effect of cultivars and both methods and rates of K_2O application; i,e. soil application (SA) and foliar application (FA) on yield and its components, potassium use efficiency (KUE), tuber root quality and its storability of some sweet potato cultivars (Beauregard and Abees).***

Beauregard cv recorded the maximum number of tubers/ plant, yield/ plant, marketable yield and total yield/fed., KUE, starch (%) in its tuber roots. Whereas cv Abees recorded maximum values of total sugars, TSS (%) and carotenoids, as well as weight loss and decay percentages in its tuber roots. Fertilization of sweet potato grown in sandy soil with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA recorded maximum values of number of tubers/ plant and yield/ plant, average tuber root / plant, marketable yield and total yield/fed, KUE, N,P, K, starch, total sugars, TSS (%) and carotenoids contents in the tuber roots. Moreover, it also recorded minimum weight loss and decay percentages in the tuber root of sweet potato during storage. Fertilization of cv Beauregard with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA was the best interaction treatment for enhancing marketable yield, total yield/fed. and KUE, as well as storability of sweet potato tuber roots.

Keywords: ***Sweet potato, Beauregard, Abees, K_2O, soil and foliar application, yield, KUE, weight loss and decay (%)***

INTRODUCTION

Sweet potato (*Ipomoea batatas,* L.) is the seventh most important food crop the worldwide, after wheat, rice, maize, potato, barley and cassava. The primary importance of sweet potato is in poor regions of the world. It is the fourth most important food crop in developing tropical countries and is grown in most of the tropical and subtropical regions of the earth, where the vine, as well as the roots, is consumed by humans and livestock (Woolfe, 1992).

Soil condition inducing K deficiency in crop plants are sandy, organic, leached and eroded soils (Fageria *et al*., 1997). Moreover leaching of K, especially in sandy soils, is a significant contributor to poor K- use efficiency in farming system (Kayser and Isselstein, 2005). Also, leaching of K may came a significant loss of K from the soil and it may be beneficial to introduce crops and genotypes that grow roots and take up more K from deep in the soil profile and transport it to aboveground plant parts (Wang *et al*., 2000).

Tuber root formation of sweet potato is positively affected by synthesis and accumulation of starch, K plays a key role in this regard as it influences cell division, tuberous root initiation and thickening, photosynthesis, formation of carbohydrates, translocations of sugars, mineral nutrients and photosynthetic matter and it also influences enzyme activity (George *et al*., 2002; Byju and George, 2005).

Under sandy conditions, *cv* Beauregard gave higher number and weight of tuber roots/ plant and both marketable and total yield/fed, P and TSS contents in tuber roots. On the other hand, *cv* Abees was higher in K, protein, total carbohydrates, starch and total sugars as well as total weight loss percentage in tuber roots (Al-Easily 2002, Ayoub, 2005 and Mandour, 2005)

Number of tuber roots/ plant, yield, average tuber root weight and tuber root quality of sweet potato; i.e, carotenoids, total sugars, total carbohydrates, TSS, starch content increased with added K_2O up to the highest rates, Bourke, 1985 (375 kg/ha.); Jian-Wei *et al*., 2001 (300 kg/ha.); George *et al*., 2002 (270 kg/ha.) and Abd El-Baky *et al*., 2010 (150 kg/fed.). Also, soil application with K_2O and foliar application with K_2O as stimulating dose significantly increased total bulb yield, bulb quality of onion (El-Bassiony, 2006 ; Ghoname *et al*., 2007) and bulb storability of garlic (El-Morsy *et al*., 2004) as compared with soil application of potassium.

The aim of this work is to know the suitable methods and rates of K_2O application to obtain a high tuber root yield and best quality as well as storability of some sweet potato cultivars grown in sandy soil.

MATERIALS AND METHODS

This research was carried out during the two successive summer seasons of 2008 and 2009 under sandy soil conditions using drip irrigation system in EL-Kassasien Horticultural Research Station, Ismailia Governorate to investigate the effect of cultivars and both methods and rates of K_2O application (soil and foliar applications) on yield and its components, potassium use efficiency, tuber root quality and its storability of sweet potato (Ipomoea *batatas* L.).

This experiment included 8 treatments, which were the combination between two cultivars;i.e., Beauregard and Abees, and four both methods

and rates of K_2O application (Schedule 1). These treatments were arranged in a split plot in a completely randomized block design with three replications. Cultivars arranged in the main plots, while both methods and rates of K_2O were randomly assigned in sub plots. Stem cuttings of about 20 cm length were transplanted at 25 cm apart, on April 25th and 29th in the 1st and 2nd seasons, respectively. The source of cultivars was El-Baramon Horticultural Research Station, Dakhlyia Governorate.

The experimental unit area was 12.6 m^2. It contains three dripper lines with 6m length each and 70 cm distance between each two dripper lines. One line was used taking samples to measure the morphological and physiological traits and the other two lines were used for yield determinations.

Schedule (1): Methods and rates of K_2O application.

K_2O soil + foliar app.	K_2O (kg/fed)	
	Soil + foliar	Total
100 %RR* + 0 %	150 + 0	150
50 %RR + 1 %	75 + 10	85
50 %RR + 2%	75 + 20	95
50 %RR + 3%	75+ 30	105

*RR: recommended rate, app: application.

Soil application (SA) treatments were divided into four equal portions, each was added at soil preparation and after 4,6 and 8 weeks from transplanting. Foliar application (FA) treatments were 2.5, 5 and 7.5 kg K_2O/250 liter water/fed in every spray, respectively, and done at 8, 10, 12 and 14 weeks after transplanting. The concentrations of K_2O in the spray solution were 1,2 and 3 % K_2O respectively (2,4 and 6 % potassium sulphate is equal to 5, 10 and 15 kg potassium sulphate /250 liter water/fed in every spray, respectively). Source of potassium fertilizer was potassium sulphate (48-52 % K_2O). The foliar spray solution was prepared by dissolving the amount of potassium sulphate in tap water before spraying. The check treatment was sprayed by tap water.

All treatments received equal amounts of ammonium sulphate (20.5 % N), and calcium superphosphate (15.5 % P_2O_5) at a rate of 200 and 150 kg/fed., respectively. One third of N amount and all amount of P_2O_5 were added during soil preparation with FYM which added at the rate of 20 m^3/fed. The rest of N was added with irrigation water (as fertigation) at weekly beginning one month after planting. The normal agricultural practices were carried out as commonly uses in the district.

Data Recorded

1. Yield and Its Components

At harvest time (150 days from transplanting), all tuber roots of each treatment were classified into two grades (marketable and non-marketable roots), then weighed to determine the total yield per feddan (ton). Marketable

tuber roots have a weight about 100 to 250 gm, while non-marketable roots have a weight of less than 100gm or more than 250 gm. In addition, average tuber root weight and yield/ plant were calculated.

2. Potassium use efficiency

$$KUE = \frac{Y_k - Y_0}{K_R} = \text{"kg tuber roots/one kg } K_2O\text{"}$$ **(Janssen, 1998)**

Where: Y_k is yield as the particular K level , Y_0 is yield at K_0 level (control) and K_R is the particular K rate.

3. Tuber root quality at harvest time

a. N, P and K Contents*:* Total nitrogen, phosphorous and potassium were determined in dried tuber root tissues as previously described in shoot.

b. Starch content*:* It was determined in dried tuber roots according to the both methods described by A.O.A.C. (1995).

c. Total soluble sugars (%): It was determined according to the both method described by Forsee (1938).

d. Total soluble solids (T.S.S. %) : It was determined in flesh juice of tuber roots by Carle Zeis refractometer.

e. Carotenoids content: It was determined in fresh tuber root tissues according to the both method reported by A.O.A.C. (1995).

4. Storability

At harvest time, the tuber roots from every plot were translocated to shady place in the same day for curing, and placed for one week. Samples of uniform cured tuber roots (5 kg) from every plot were put in palm crates and stored at normal room temperature and relative humidity. The storage zero time was October 1st, while the end time of storage was February 1st in both seasons. The average room temperature and relative humidity (RH%) during storage months are presented in Table (1).

Table (1): The average room temperature (^oC) and relative humidity (%) storage months

Month	Temperature (^oC)		Relative humidity (%)	
	2008/2009	2009/2010	2008/2009	2009/2010
Oct.	30.5	32.2	76	78
Nov.	26.4	28.4	79	83
Dec.	21.6	22.6	80	85
Jan.	21.1	20.7	88	84

The following data were monthly recorded in both seasons

a. Weight loss (%) : Tuber roots of each treatment were weighed at 30 days by intervals, then the cumulative weight loss percentage was calculated.

b. Decay (%): Decayed tuber roots were removed and weighed. They included all spoiled tuber roots resulting from fungal or bacterial infections. The percentage of decayed tuber roots was calculated in relation to the total initial weight of stored tuber roots.

Statistical analysis: Recorded data were subjected to the statistical analysis of variance according to Snedecor and Cochran (1980), and means separation were done according to LSD at 5 % level.

RESULTS AND DISCUSSION

1. Yield and Its Components

a. Effect of cultivars

The obtained results in Table 2 show that, the effect of cultivars on yield and its components was significant, except average tuber root weight in the 2nd season and unmarketable yield in both seasons. Beauregard *cv* grown in sandy soil produced number of tubers/ plant (4.33 and 4.27), yield/ plant (0.596 and 0.514 kg/ plant), total yield (14.310 and 12.340 ton/fed) and marketable yield (13.412 and 11.616 ton/fed) and in the 1st and 2nd seasons, respectively. It was yielder more than *cv* Abees in both seasons. Whereas, there were no significant differences between them with respect to average tuber roots and unmarketable yield. The increases in total yield were about 21.77 and 27.58 % for *cv* Beauregard compared with *cv* Abees in the 1st and 2nd seasons, respectively. The increments in total yield of Beauregard *cv* were mainly due to the increase in number of tuber roots/plant, rather than average tuber root weight.

The varietals differences between the studied cultivars may be due to the heredity differences and also may be due to the differences between them in their yield attributes. Similar findings were reported by Al-Esaily (2002), Ayoub (2005) and Mandour (2005) on sweet potato under sandy soil conditions.

b. Effect of both methods and rates of K_2O application

Data in Table 2 show that, both methods and rates of K_2O application had significant effect on yield and its components in both seasons. Fertilization of sweet potato grown in sandy soil with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA recorded the maximum values of number of tuber roots/ plant and yield/ plant, whereas fertilization with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA recorded that maximum values of average tuber root / plant, marketable yield (14.161 and 12.171 ton/fed) and total yield/fed (15.105 and 12.948 ton/fed) in the 1st and 2nd seasons, respectively followed by fertilization with100 % RR of K_2O as SA. On the other hand, fertilization with 100 % RR of K_2O as SA gave the highest unmarketable yield/fed.

Table 2

The increases in total yield were about 50.56 and 44.51 % for treatment of 50 % RR of K_2O as SA combined with K_2O at 3 % as FA and 46.97 and 33.88 % for treatment of 100 % RR of K_2O as SA over that of 50% RR of K_2O as SA combined with K_2O at 1 % as FA in 1st and 2nd seasons, respectively.

Tuber root formation of sweet potato is positively affected by synthesis and accumulation of starch, since K plays a key role in this regard as it influences cell division, tuberous root initiation and thickening, photosynthesis, formation of carbohydrates, translocations of sugars, mineral nutrients and photosynthetic matter and it also influences enzyme activity (George *et al*., 2002; Byju and George, 2005).

El-Bassiony (2006) found that soil application with 200 kg/fed K_2SO_4 and foliar application with K_2O (1g/l) as stimulating dose was the superior treatments for enhancing yield and bulb quality of onion as compared with soil application of K_2O. Similar results were reported by El-Morsy *et al*. (2004) on garlic and Ghoname *et al*. (2007) on onion.

c. Effect of the interaction

Data presented in Table (3) show that, the interaction between cultivars and both methods and rates of K_2O application reflected a significant effect on yield and its components. Beauregard plants which fertilized with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA recorded the maximum values of number of tuber roots/ plant, yield (kg/plant) and average tuber root weight, followed by Beauregard plants fertilized with 100 % RR of K_2O as SA. Moreover Beauregard plants which fertilized with 100 % RR of K_2O as SA or with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA recorded the maximum values of marketable and total yield (ton/fed) followed by *cv* Abees plants which fertilized with the same treatments.

From foregoing results, it could be conclude that, the best interaction treatments for cv Beauregard were with 100 % RR of K_2O as SA followed by fertilization with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA. Moreover, fertilization of cv Abees with 50% RR of K_2O as SA combined with 3 % K_2O as FA, followed by fertilization with 100 % RR of K_2O as SA were the best interaction treatments for enhancing marketable and total yield/fed. in this respect.

The increases in the marketable and total yield for *cv* Beauregard were about 0.273 and 0.591 ton/fed for marketable yield and 0.416 and 0.856 ton/fed for total yield when fertilized with 100 % RR of K_2O as SA over that when fertilized with 50 % RR of K_2O as SA combined with 3 % K_2O as FA. Also the increases in marketable yield and total yield/fed for *cv* Abees were about 1.427 and 2.917 ton/fed for marketable yield and 1.137 and 2.760 ton/fed for total yield/fed when fertilized with 50 % RR of K_2O as SA combined with 3 % K_2O as FA over the fertilization with 100 % RR of K_2O as SA in the 1st and 2nd seasons, respectively.

Table 3

This means that fertilization of *cv* Beauregard grown in sandy soil with 100 % RR K_2O (150 kg K_2O) as SA and fertilization of *cv* Abees with 50 % RR of K_2O (75 kg K_2O) as SA+ 3 % K_2O (30 kg K_2O) as FA recorded the maximum values of marketable and total yield/fed in both seasons.

2. Potassium Use Efficiency (KUE)

a. Effect of cultivars

Data presented in Table 4 show that, in general, *cv* Beauregard recorded higher values of KUE (42.32 and 17.89 kg tuber root/ 1kg K_2O in the 1st and 2nd seasons, respectively) than *cv* Abees (26.23 and 29.50 kg tuber root/ 1kg K_2O in the 1st and 2nd seasons, respectively). In sandy soils, leaching of K may came a significant loss of K from the soil, and it may be beneficial for crops and genotypes that grew roots and take up more K from deep in the soil profile and transport it to aboveground plant parts (Wang *et al*., 2000).

b. Effect of both methods and rates of K_2O application

Fertilization with 50 % RR of K_2O as SA combined with 3 % K_2O as FA recorded the maximum values of KUE by sweet potato plants (48.31 and 37.97 kg tuber roots /1 kg K_2O in the 1st and 2nd seasons, respectively) followed by fertilization with 100 % RR as SA (Table 4).

Table (4): Effect of both methods and rates of potassium application on potassium use efficiency (KUE) of some sweet potato cultivars grown in sandy soil during summer seasons of 2008 and 2009

Characters / Treatments	Beauregard		Abees		Average	
K_2O as SA + FA	1st	2nd	1st	2nd	1st	2nd
100 %RR + 0 %	41.12	20.16	21.71	20.32	31.42	20.24
50 %RR + 1%	---	--	--	--	--	--
50 %RR + 2%	31.07	11.53	15.41	12.88	23.24	12.20
50 %RR + 3%	54.78	20.64	41.84	55.31	48.31	37.97
Average	42.32	17.44	26.32	29.50	--	--

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate
1st : 1st season 2008 , 2nd : 2nd season 2009

c. Effect of the interaction

Presented data in Table 4 show that in both cultivars, (Beauregard and Abees), fertilization with 50 % RR of K_2O as SA combined with 3 % K_2O as FA were the best interaction treatments for increasing KUE in both seasons (54.78 and 20.62 kg tuber roots / 1 kg K_2O for *cv* Beauregard and 41.84 and 55.31 kg tuber roots/ 1 kg K_2O for *cv* Abees in the 1st and 2nd seasons, respectively). George *et al*. (2002) reported that K utilization efficiency was positively correlated with total plant biomass and root yield of sweet potato. Also, Gerloff (1987) found that genotypic differences in capacity to utilize

potassium can be attributed to differences in the (1) partitioning and redistribution of K at a cellular or whole plant level, (2) substitution of K with other ions, and /or (3) the partitioning of resources into the economic product.

3. Tuber Root Quality

a. Effect of cultivars

Results in Table (5) reveal that there were significant differences between cvs Beauregard and Abees in starch, total sugars, TSS(%) and carotenoids content in tuber root of sweet potato. Tuber roots of *cv* Abees had higher total sugars, TSS (%) and carotenoids than that of Beauregard. On the other hand, tuber roots of Beauregard were rich in starch (%) than tuber roots of Abees. There were no significant differences between both cvs with respect to N, P and K contents in their roots. The differences in nutritive value between the two cultivars were mainly due to the genetic architecture of each. The differences between the two cultivars in their chemical constituents were also reported by Al-Esaily (2002), Ayoub (2005) and Mandour (2005).

b. Effect of both methods and rates of K_2O application

As seen from data in Table 5, the methods and rates of K_2O application had significant effect on tuber root chemical constituents. Fertilization of sweet potato with 100 % RR of K_2O as SA or with 50 % RR of K_2O as SA combined with 3 % K_2O as FA significantly increased N,P, K, starch, total sugars, TSS (%) and carotenoids content in tuber roots compared to other treatments in both seasons. Potassium helps sugars and carbohydrates to translocate from leaves to tuber roots. These results agree with those reported by Bourke (1985), Jian-Wei *et al*. (2001), George *et al*. (2002) and Abd El-Baky *et al.* (2010) on sweet potato.

c. Effect of the interaction

The interaction between cultivars and both methods and rates of potassium application reflected a significant effect on chemical constituents of tuber roots of sweet potato (Table 6). In general, Beauregard plants when fertilized with 100 % RR of K_2O as SA gave the highest values of N, P, K and starch content in its tuber roots. Whereas, Abees plants when fertilized with 100 % RR of K_2O as SA or 50 % RR of K_2O as SA combined with 3 % K_2O as FA gave the highest values of total sugars, TSS (%) and carotenoids in tuber roots compared to other treatments.

Table 5

Table 6

4. Storability

a. Effect of cultivars

Results in Table (7) show that the percentages of weight loss and decay (%) in tuber roots gradually increased with the progress of storage period up to four months in both cultivars. In addition there were significant differences between the two cultivars regarding weight loss and decay percentages at different periods of storage. Beauregard recorded weight loss and decay in tuber roots less than cv. Abees during storage periods in both seasons. These results may be due to that Abees tuber roots had low starch, high sugars content (Table 5). sugars may be consumed in respiration which in turn may course higher weight loss and decay. These results agree with those obtained by Al-Esaily (2002), Ayoub (2005) and Mandour (2005) on sweet potato.

b. Effect of both methods and rates of K_2O application

The obtained results (Table 7) indicate that, weight loss and decay percentages in tuber roots of sweet potato significantly increased with different methods and rates of K_2O application. Fertilization of sweet potato with 100 RR of K_2O as SA recorded the lowest values of the percentages of weight loss and decay in the tuber roots during storage period followed by fertilization with 50 % RR of K_2O as SA combined with 3 % K_2O as FA. Moreover, fertilization with 50 % RR of K_2O as SA combined with 1 % K_2O as FA showed the highest values of the percentages of weight loss and decay during storage period, hence decreased the shelf life of the tuber roots after harvest.

These results are in harmony with those reported by El-Morsy *et al.* (2004), who found that storability of garlic bulbs significantly increased by plants received K-fertilizer as 50% soil application + foliar application.

c. Effect of the interaction

Data in Table 8 show that during storage period the percentages of weight loss and decay in tuber roots of sweet potato significantly affected by the interaction between cultivars and both methods and rates of K_2O application. Beauregard plants which fertilized with 100 RR of K_2O as SA recorded the minimum values of the percentages of weight loss and decay of the tuber roots followed by plants those fertilized with 50 % RR of K_2O as SA combined with 3 % K_2O as FA. Nevertheless, plants of *cv* Abees when fertilized with 50% RR of K_2O as SA combined with 1 % K_2O as FA recorded maximum values of weight loss and decay (%)compared to other treatments.

Finally, it could be concluded that, fertilization of Beauregard plants with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA was the best

treatment for enhancing marketable, total yield and KUE, as well as storability of sweet potato under sandy soil conditions.

Table 7

Table 8

REFERENCES

A.O.A.C. Association of Official Agricultural Chemists (1995). Official systems of analysis. 17th. ed. A.O.A.C., Wash., D.C

Abd El-Baky, M.M.H., A.A. Ahmed, M.A. El-Nemr and M.F. Zaki (2010). Effect of potassium fertilizer and foliar zinc application on yield and quality of sweet potato. Res. J. Agric. and Biol. Sci., 6(4): 386-394,

Al-Esaily, I. A. (2002). Response of some sweet potato cultivars to different agricultural treatments under sandy soil conditions. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt

Ayoub, I. I. (2005). Effect of fertigation and plant population on growth, yield and storability of sweet potato grown under sandy soil conditions. Ph.D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Bourke, R. M., (1985). Influence of nitrogen and potassium fertilizer on growth of sweet potato *(Ipomoea batatas, L.)* in Papua New Guinea. Field Crops Res. 12, 363-375

Byju, G. and J. George (2005). Potassium nutrition of sweet potato. Adv. Hort. Sci. 19:221-239.

El-Bassiony, A. M., (2006). Effect of potassium fertilization on growth, yield and quality of onion plants. J. Appl. Sci. Res., 2(10): 780-785.

El-Morsy, A. H. A., Z. S. El-Shal and Sawsan M. H. Sarg (2004). Effect of potassium application both methods and some micronutrients on growth, yield and storability of garlic. J. Agric. Sci. Mansoura Univ., 29 (4): 2013 – 2023.

Fageria, N. K., V.C. Ballgar and C.A. Jones (1997). Growth and nutrition of filed crops 2nd ed. Marcel Dekker, Inc. New York, Pp. 85.

Forsee, W. T. Jr. (1938). Determination of sugar in plant materials A photometeric both method. Indus. Eng. Chem. Anal. Ed. 10:411-418.

George, M. S., L. Guoquan and Z. Weijun (2002). Genotypic variation for potassium uptake and utilization efficiency in sweet potato *(Ipomoea batatas* L.). Filed Crops Res. 77: 7-15.

Gerloff, G .C. (1987). Intact-plant screening for tolerance to nutrient-deficiency stress. Plant Soil 99: 3–16

Ghoname, A., Z. F. Fawzy, A. M. El-Bassiony, G. S. Riadand and M.M.H. Abd El-Baky (2007). Reducing onion bulbs flaking and increasing bulb yield and quality by potassium and calcium application. Aust. J. of Basic and Appl. Sci. 1(4): 610-618.

Janssen, B. H. (1998). Efficient use of nutrients. Field Crops Res. 56:197-201.

Kayser, M. and J. Isselstein (2005). Potassium cycling and losses in grassland systems: a review. Grass and Forage Sci. 60 (3): 213-224.

Jian-Wei, L., F. Chen, S. Xu You, Y. Xu, Y. Wan and D. Liu (2001). Sweet potato response to potassium. Better Crops International 15 (1) : 10-12

Mandour. M, A. (2005). Effect of biofertilizers and harvesting dates on growth, yield and keeping quality of some sweet potato cultivars under sandy soil conditions. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt

Snedecor, G. W. and W.G. Cochran (1980). Statistical Methods.7th ed. Iowa State Univ., Press, Ames., Iowa, U.S.A.

Wang, J. G., F. S. Zhang, X.L. Zhang and Y.P. Cao (2000). Release of potassium from K-bearing minerals: effect of plant roots under P deficiency. Nutr Cycl Agroecosys 56: 45–52

Woolfe, J. A. (1992). Sweet potato: an untapped food resource. New York: Cambridge University Press.

استجابة بعض أصناف البطاطا لطرق ومعدلات إضافة البوتاسيوم تحت ظروف الأرض الرملية

٣- المحصول وكفاءة استخدام البوتاسيوم وجودة الجذور المتدرنة والقدرة التخزينية

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الملخص العربي

أجرى هذا البحث خلال الموسمين الصيفين المتتاليين لعامي ٢٠٠٨ ، ٢٠٠٩ فى مزرعة محطة بحوث البساتين بالقصاصين، بمحافظة الاسماعلية ويهدف الى دراسة استجابة نبات البطاطا لطريقة ومعدل إضافة البوتاسيوم (إضافة أرضية وإضافة عن طريق الرش) على المحصول وكفاءة استخدام البوتاسيوم وجودة الجذور المتدرنة والقدرة التخزينية لبعض أصناف البطاطا (بيوروجارد وأبيس) تحت ظروف الأرض الرملية وباستخدام نظام الري بالتنقيط.

ويمكن إيجاز أهم النتائج المتحصل عليها فيما يلي :

(١) سجل الصنف بيوروجارد أعلى القيم للعدد الجذور المتدرنة ومحصول النبات ،والمحصول القابل للتسويق والمحصول الكلى للفدان، وكفاءة استخدام البوتاسيوم وكذلك محتوى الجذور من النشا، بينما سجل الصنف أبيس أعلى القيم للسكريات الكلية ونسبة المواد الصلبة الكلية ومحتوى الجذور من الكاروتين، وكذلك النسبة المئوية للفقد في الوزن والتلف أثناء تخزين الجذور.

(٢) أعطى تسميد البطاطا في الأرض الرملية بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% أعلى القيم لعدد الجذور المتدرنة

ومحصول النبات ومتوسط وزن الجزر والمحصول القابل للتسويق والمحصول الكلى للفدان وكفاءة استخدام البوتاسيوم وكذلك محتوى الجذور من النيتروجين والفوسفور والبوتاسيوم والنشا (%) والسكريات الكلية ونسبة المواد الصلبة الذائبة والكاروتين، وقد سجلت هذه المعاملة أيضا اقل القيم للنسبة المئوية للفقد في الوزن والتلف أثناء تخزين الجذور .

(٣) كانت أفضل معاملة تفاعل عند تسميد الصنف بيوروجارد بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% والتى أعطت أكبر زيادة في كل من المحصول القابل للتسويق والمحصول الكلى للفدان وكفاءة استخدام البوتاسيوم والقدرة التخزينية للجذور .

Response of some sweet potato cultivars to methods and .....

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Table (2): Effect of both methods and rates of potassium application on yield and its components of some sweet potato cultivars grown in sandy soil during summer seasons of 2008 and 2009

Characters / Treatments	Number of root/ plant		Yield / plant (kg)		Average of tuber root weight (gm)		Yield (ton/*fed*)							
							Marketable		Non -marketable		Total		Relative (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	Effect of cultivars													
Beauregard	4.43	4.27	0.596	0.514	166	124	13.412	11.616	0.898	0.724	14.310	12.340	121.77	127.58
Abees	3.28	3.30	0.489	0.403	148	125	10.883	9.020	0.868	0.652	11.751	9.672	100.00	100.00
LSD at 0.05 level	0.37	0.18	0.031	0.025	12.4	NS	0..680	0.434	NS	NS	0.621	0.946	--	--
K_2O as SA + FA	Effect of methods and rates of K_2O application													
100 %RR + 0 %	3.77	3.23	0.614	0.499	162	155	13.583	11.008	1.161	0.988	14.745	11.996	146.97	133.88
50 %RR + 1%	3.45	4.32	0.418	0.373	136	85	9.405	8.531	0.627	0.429	10.032	8.960	100.00	100.00
50 %RR + 2%	3.94	4.18	0.510	0.421	160	101	11.441	9.561	0.798	0.559	12.240	10.120	122.00	112.94
50 %RR + 3%	4.27	3.43	0.629	0.539	171	157	14.161	12.171	0.944	0.777	15.105	12.948	150.56	144.51
LSD at 0.05 level	0.26	0.12	0.022	0.010	8.8	8.7	0.483	0.308	0.089	0.123	0.444	0.677	--	--

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate

1st : 1st season 2008 , 2nd : 2nd season 2009

Table (3): Effect of the interaction between both methods and rates of potassium application on yield and its components of some sweet potato cultivars grown in sandy soil during summer seasons of 2008 and 2009

Treatments		Number of root/ plant		Yield / plant (kg)		Average of tuber root weight (gm)		Yield (ton/*fed*)							
								Marketable		Non -marketable *		Total		Relative (%)	
CVS	K_2O as SA + FA	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Beauregard	100 %RR + 0 %	4.15	3.80	0.698	0.574	168	151	15.615	12.724	1.145	1.068	16.760	13.792	158.33	128.08
	50 %RR + 1%	3.93	4.73	0.441	0.448	139	94	10.011	10.319	0.581	0.449	10.592	10.768	100.00	100.00
	50 %RR + 2%	4.79	5.05	0.564	0.494	174	97	12.681	11.287	0.863	0.577	13.544	11.864	127.87	110.17
	50 %RR + 3%	4.88	3.51	0.681	0.539	185	153	15.342	12.133	1.002	0.803	16.344	12.936	154.30	120.13
Abees	100 %RR + 0 %	3.39	2.66	0.530	0.425	156	160	11.552	9.292	1.177	0.908	12.729	10.200	134.38	142.61
	50 %RR + 1%	2.97	3.91	0.394	0.298	132	76	8.799	6.743	0.673	0.409	9.472	7.152	100.00	100.00
	50 %RR + 2%	3.10	3.31	0.455	0.349	146	105	10.202	7.835	0.734	0.541	10.936	8.376	115.49	117.11
	50 %RR + 3%	3.67	3.35	0.577	0.540	157	160	12.979	12.209	0.887	0.751	13.866	12.960	146.38	181.20
LSD at 0.05 level		0.37	0.18	0.031	0.015	12.5	12.5	0.678	0.440	0.125	0.184	0.628	0.960	--	--

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate

1st : 1st season 2008 , 2nd : 2nd season 2009

Table (5): Effect of both methods and rates of potassium application on tuber roots quality of some sweet potato cultivars at harvest time during summer seasons of 2008 and 2009

Characters / Treatments	Mineral contents (%)						Starch (%)		Total sugar (%)		TSS		Carotenoides (mg/gm FW)	
	N		P		K									
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	Effect of cultivars													
Beauregard	0.98	0.96	0.492	0.497	1.87	1.58	53.12	59.80	8.57	8.935	9.12	9.09	8.07	7.97
Abees	1.05	0.96	0.504	0.491	1.89	1.70	51.63	54.67	12.04	11.35	10.87	11.03	11.60	11.78
LSD at 0.05 level	NS	NS	NS	NS	NS	NS	NS	2.43	1.24	0.73	0.37	0.31	1.21	0.70
K_2O as SA + FA	Effect of methods and rates of K_2O application													
100 %RR + 0 %	1.15	1.15	0.510	0.518	2.22	1.80	61.83	60.12	10.89	10.90	11.08	10.40	11.53	11.16
50 %RR + 1%	0.94	0.73	0.481	0.484	1.66	1.34	45.40	51.94	9.91	8.94	9.17	9.20	8.31	8.50
50 %RR + 2%	0.98	0.89	0.491	0.476	1.75	1.58	47.70	56.98	10.12	9.89	9.75	10.23	8.77	8.82
50 %RR + 3%	1.01	1.07	0.511	0.498	1.91	1.84	54.56	59.89	10.32	10.84	10.00	10.40	10.75	11.02
LSD at 0.05 level	0.11	0.14	0.009	0.016	0.22	0.17	2.66	1.77	0.88	0.52	0.26	0.21	0.88	0.49

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate

1st : 1st season 2008 , 2nd : 2nd season 2009

Table (6): Effect of the interaction between both methods and rates of potassium application on tuber roots quality of some sweet potato cultivars at harvest time during summer seasons of 2008 and 2009

Characters / Treatments		Mineral contents (%)						Starch (%)		Total sugar (%)		TSS		Carotenoids (mg/gm FW)	
		N		P		K									
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
CVS	K_2O as SA + FA														
Beauregard	100 %RR + 0 %	1.11	1.19	0.528	0.533	2.44	1.87	66.27	64.04	9.35	9.190	9.67	9.14	9.23	9.75
	50 %RR + 1%	0.95	0.66	0.513	0.474	1.64	1.26	46.23	52.72	7.97	7.530	8.67	8.24	7.37	6.86
	50 %RR + 2%	0.91	0.89	0.459	0.484	1.56	1.46	44.92	61.83	8.59	9.540	8.67	8.97	7.54	7.09
	50 %RR + 3%	0.97	1.12	0.469	0.498	1.87	1.73	55.06	60.61	8.40	9.480	9.50	10.03	8.17	8.20
Abees	100 %RR + 0 %	1.19	1.11	0.492	0.503	2.01	1.74	57.40	56.20	12.44	12.620	12.50	11.67	13.83	12.58
	50 %RR + 1%	0.93	0.80	0.448	0.494	1.68	1.42	44.57	51.17	11.85	10.360	9.67	10.17	9.25	10.14
	50 %RR + 2%	1.05	0.90	0.523	0.469	1.94	1.70	50.49	52.14	11.65	10.240	10.83	11.50	10.00	10.55
	50 %RR + 3%	1.05	1.03	0.553	0.498	1.95	1.95	54.07	59.18	12.24	12.200	10.50	10.78	13.33	13.85
LSD at 0.05 level		0.16	0.19	0.012	0.022	0.31	0.25	3.75	2.51	1.25	0.73	0.37	0.31	1.25	0.71

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate
1st : 1st season 2008 , 2nd : 2nd season 2009

Table (7): Effect of both methods and rates of potassium application on tuber root storability of some sweet potato cultivars during summer seasons of 2008 and 2009

Characters / Treatments	Weight loss (%)								Decay (%)							
	Days from storage															
	30		60		90		120		30		60		90		120	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	Effect of cultivars															
Beauregard	6.32	6.09	20.07	21.35	30.95	37.19	41.94	49.37	0.0	0.0	1.47	3.17	4.01	4.20	7.585	7.85
Abees	12.95	12.48	22.62	31.25	35.38	47.19	50.12	63.03	٠.0	0.0	3.94	3.32	6.50	8.97	11.62	14.23
LSD at 0.05 level	1.82	1.24	NS	3.71	NS	6.20	4.32	2.43	--	--	0.60	NS	1.21	0.73	1.86	3.10
K_2O as SA + FA	Effect of methods and rates of K_2O application															
100 %RR + 0 %	8.17	5.87	18.62	21.15	28.00	35.22	38.83	46.64	0.0	0.0	1.32	1.56	3.665	3.66	8.05	5.91
50 %RR + 1%	11.58	12.77	24.73	35.52	39.90	52.95	54.19	69.12	0.0	0.0	4.10	6.55	7.145	10.69	12.72	19.17
50 %RR + 2%	10.35	11.04	22.26	28.43	33.32	46.08	50.41	61.50	0.0	0.0	3.52	3.38	6.215	9.07	10.44	12.93
50 %RR + 3%	8.45	7.46	19.79	20.09	31.44	34.51	40.69	47.55	0.0	0.0	1.89	1.50	4.010	2.93	7.20	6.15
LSD at 0.05 level	1.32	0.88	2.21	2.64	3.97	4.43	3.11	1.77	--	--	0.43	0.21	0.86	0.52	1.32	2.21

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate
1st : 1st season 2008 , 2nd : 2nd season 2009

Table (8): Effect of the interaction between both methods and rates of potassium application on tuber root storability of some sweet potato cultivars during summer seasons of 2008 and 2009

Characters / Treatments		Weight loss (%)								Decay (%)							
		Days from storage															
		30		60		90		120		30		60		90		120	
CVS	K_2O as SA + FA	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Beauregard	100 %RR + 0 %	5.47	4.09	17.66	18.54	26.59	32.67	35.49	43.74	0.0	0.0	0.52	0.83	2.98	1.90	6.85	3.16
	50 %RR + 1%	7.23	8.65	22.47	28.17	34.30	47.56	47.72	58.69	0.0	0.0	2.39	5.56	5.55	8.66	9.10	15.74
	50 %RR + 2%	6.81	5.73	21.26	21.00	32.32	37.42	47.23	50.24	0.0	0.0	1.87	3.71	4.35	5.18	8.43	7.48
	50 %RR + 3%	5.78	5.90	18.91	17.69	30.61	31.11	37.32	44.84	0.0	0.0	1.12	2.59	3.18	1.08	5.96	5.02
Abees	100 %RR + 0 %	10.87	7.65	19.58	23.77	29.42	37.77	42.17	49.55	0.0	0.0	2.13	2.30	4.35	5.42	9.25	8.66
	50 %RR + 1%	15.93	16.80	26.99	42.87	45.51	58.35	60.66	79.55	0.0	0.0	5.81	7.54	8.74	12.72	16.35	22.61
	50 %RR + 2%	13.89	16.30	23.26	35.87	34.33	54.75	53.59	72.77	0.0	0.0	5.18	3.05	8.08	12.96	12.46	18.39
	50 %RR + 3%	11.13	9.02	20.67	22.50	32.28	37.92	44.06	50.27	0.0	0.0	2.67	0.42	4.84	4.78	8.45	7.29
LSD at 0.05 level		1.87	1.25	3.14	3.75	5.63	6.28	4.37	2.51	--	--	0.61	0.30	1.23	0.73	1.87	3.14

100 % K_2O = 150 kg /fed , 50 % K_2O = 75 kg /fed, 1 % K_2O = 10 kg/fed , 2 % K_2O = 20 kg/fed , 3 % K_2O = 30 kg/fed , SA: Soil application , FA: Foliar application and RR: Recommended rate
1st : 1st season 2008 , 2nd : 2nd season 2009