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

١- النمو الخضرى والمحتوى الكيماوى للنبات

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الملخص العربي

أجرى هذا البحث خلال الموسمين الصيفين المتتاليين لعامى ٢٠٠٨ ، ٢٠٠٩ بمزرعة محطة بحوث البساتين بالقصاصين ، بمحافظة الاسماعلية ، ويهدف الى دراسة استجابة نباتات البطاطا لطرق ومعدلات إضافة البوتاسيوم (إضافة أرضية وإضافة عن طريق الرش) على النمو الخضرى والمحتوى الكيماوى لنبات بعض أصناف البطاطا (بيوروجارد وأبيس) تحت ظروف الأرض الرملية وباستخدام نظام الرى بالتنقيط ، وكانت النتائج كما يلى :

(١) أوضحت النتائج أن الصنف أبيس أعطى أعلى القيم لطول الفرع الرئيسى وعدد الأفرع للنبات والمساحة الورقية للنبات والوزن الجاف لعرش النبات وكذلك محتوى العرش من النيتروجين والفوسفور والبوتاسيوم ، بينما سجل الصنف بيوروجارد أعلى تركيز للكاروتينات فى أنسجة الورقة .

(٢) أعطى تسميد البطاطا فى الأرض الرملية بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% أعلى القيم لصفات طول الفرع الرئسى وعدد الأفرع للنبات والمساحة الورقية للنبات والوزن الجاف لعرش النبات ومحتوى أنسجة الورقة من كلوروفيل أ و ب والكلوروفيل الكلى والكاروتينات ، وكذلك محتوى العرش من كل من النيتروجين والفوسفور والبوتاسيوم والممتص منهم بواسطة نباتات البطاطا.

(٣) تشير النتائج إلى أن أفضل معاملة تفاعل لطرق ومعدلات إضافة البوتاسيوم كانت عند تسميد الصنف آبيس بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% والتى أعطى أكبر زيادة في كل من (الوزن الجاف للعرش ومحتوى الورقة من الكاروتينات وكذلك محتوى العرش من كل من النتروجين والفوسفور والبوتاسيوم والممتص منهم).

RESPONSE OF SOME SWEET POTATO CULTIVARS TO BOTH METHODS AND RATES OF POTASSIUM APPLICATION UNDER SANDY SOIL CONDITIONS 1- GROWTH AND PLANT CHEMICAL CONSTITUENTS

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ABSTRACT : ***This experiment 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 study the effect of both both methods and rates of K_2O application; i.e., soil application (SA) and foliar application (FA) on plant growth, photosynthetic pigments and N,P and K content in shoots of some sweet potato cultivars (Beauregard and Abees).***

Abees cv. recorded taller plants and gave higher values of number of branches/ plant , leaf area/ plant and shoot dry weight/ plant, N,P and K uptake by shoots, whereas Beauregard cv. gave higher concentration of carotenoids in their leaf tissues. Fertilization of sweet potato grown in sandy soil with 50 % (recommended rate) RR of K_2O as soil application (SA) combined with K_2O at 3 % foliar application (FA) recorded the maximum values of vine length , number of branches/ plant, leaf area and shoot dry weight / plant, chlorophyll a, b and total chlorophyll (a+b) as well as carotenoids in leaf tissues, N,P and K contents and their uptake in shoots of sweet potato. Fertilization of cv. Abees with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA was the best treatment for enhancing shoot dry weight/ plant, carotenoids in leaf tissues, N,P and K contents and their uptake in shoots of sweet potato.

Keywords: ***Sweet potato, Beauregard, Abees, K_2O, soil and foliar application, growth, plant chemical composition***

INTRODUCTION

Sweet potato (*Ipomoea batatas*, L.) produces highest amount of calories per unit land area than most of the energy yielding crops (Agata, 1979) This makes the crop have a high potential as raw material for industrial products such as starch, flour, alcoholic beverages and confectionery. Natural food

colorings too (like anthocyanin and carotene from purple and orange flesh sweet potato, respectively) have been processed from certain genotypes (Hagenimana *et al*., 1999 ; Yoshinage, 2000).

Potassium uptake by plant from the soil solution is regulated by several factors including soil texture, moisture conditions, pH, aeration and temperature (Mengel and Kirkby, 1987). Therefore during growth development, soil potassium supply is seldom adequate to support crucial processes such as sugar transport from leaves to tuber roots, enzyme activation, protein synthesis and cell extension that ultimately determine tuber root yield and quality (Williams and Kafkafi, 1998). Thus using a simulative dose of potassium through foliar application could be a simple solution to overcome the unavailability of potassium in the plants.

Regarding differences among sweet potato cultivars, Nin and Gilsanz (1998) evaluated four sweet potato cultivars and found differences among them in leaf area, N and K contents under different levels of N and K . Also, under sandy soil conditions *cv* Beauregard gave highest N,P and K contents in shoots, whereas, *cv* Abees gave highest dry weight of shoots/ plant (Al-Easily, 2002 ; Ayoub, 2005 ; Mandour, 2005).

Growth parameters of sweet potato; i.e., vine length, number of both leaves and branches/ plant , leaf area , dry weight of shoots/ plant and total plant dry weight of sweet potato were significantly increased with increasing levels of K nutrition (Bourke, 1985; George *et al*., 2002; El-Hadidi and Mansour, 2008 ; Abd El-Baky *et al*., 2010).

Soil application with K_2O and foliar application with K_2O as stimulating dose increased plant growth; i.e., plant height, number of leaves / plant and shoot dry weight/ plant, N,P and K contents in leaves (El-Morsy *et al*., 2004, on garlic and El-Bassiony , 2006 on onion) as compared with soil application of potassium. Also, Gunadi (2009) applied half rate of K_2O at planting , a quarter rate at 6 weeks after planting and another quarter rate by spraying it as foliar at 7,8 and 9 weeks after planting increased K content in leaves of potato.

Therefore, the objective of this work was to know the suitable of both both method and rate of potassium applications to obtain a good growth and plant chemical constituents of some sweet potato cultivars grown in sandy soil.

MATERIALS AND METHODS

This experiment was carried out during two successive summer seasons of 2008 and 2009 under sandy soil conditions using drip irrigation system. The experiment was carried out at EL-Kassasien Horticultural Research Station, Ismailia Governorate to study the effect of each of method and rate of K_2O application (soil application and foliar application) on plant growth,

photosynthetic pigments and plant chemical constituents of some sweet potato cultivars. The physical and chemical analysis of the soil are presented in Table (1).

Table 1: The physical and chemical properties of the experimental soil

Physical properties			Chemical properties		
	2008	2009		2008	2009
Sand (%)	92.5	90.6	Organic matter(%)	0.03	0.08
Silt (%)	5.7	6.6	Available K (ppm)	51	64
Clay	1.8	2.8	Available P (ppm)	5.3	5.9
Texture	Sandy	Sandy	Available N (%)	5.8	6.2
			Calcium carbonate (%)	0.23	0.29
			pH	8.2	8.3

This experiment included 8 treatments which were the combination between two cultivars (Beauregard and Abees) and four both methods and rates of K_2O application was presented in 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 assigned at random in the sub plots. Stem cuttings of about 20 cm length were transplanted at 25 cm apart, on April 25th and 29th in the 1st and the 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 drippers lines. One line was used for taking samples to measure the morphological and physiological traits and the other two lines were used for yield determinations.

Schedule 1. Method and rate 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) of K_2O treatments was divided into four equal portions , each was added at soil preparation 4,6 and 8 weeks from

transplanting, while foliar application (FA) treatments were added at 2.5, 5 and 7.5 kg K_2O/250 liter water/fed in every spray, respectively and done at four times, i.e., 8,10,12 and 14 weeks after transplanting . The concentration 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 sub plots 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) weekly beginning one month after planting. The normal agricultural practices were carried out as commonly uses in the district.

Data Recorded

1.Plant Growth : A random sample of five plants from every sub plot were randomly taken at 110 days after transplanting in the two growing seasons to measure the following parameters:

a. Vine length and number of branches/plant,

b. Leaf area/plant: It was calculated according to the formula described by Koller (1972) as follow:

$$\text{Leaf area } (m^2) = \frac{\text{Dry weight of leaves}}{\text{Dry weight of disks}} \times \text{No. of disks} \times \text{disk area}$$

c. Dry weight of canopy: Leaves and branches of each plant were dried at 70 C^o till constant weight and then weighed.

c. Relative shoot d.w.

2. Plant Chemical Constituents

a. Photosynthetic pigments

A random sample of leaves (the fourth subtermil one) from every experimental unit was randomly taken at 110 days after transplanting to determine chlorophyll a and b, as well as carotenoids according to the both method described by Wettestein (1957).

b. Contents and Uptake of N, P and K in Shoots:

Total nitrogen, phosphorus and potassium percentages in shoots (leaves and branches) were determined in dry matter according to the both methods described by A.O.A.C. (1995).

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. Plant Growth

a. Effect of cultivars

Data presented in Table (2) show that, there were a significant differences between cvs Beauregard and Abees regarding vine length, number of branches/ plant and shoot dry weight/ plant. Abees *cv* recorded taller plants and gave higher values of number of branches/ plant , leaf area/ plant and shoot dry weight/ plant than *cv* Beauregard in both seasons. The increases in shoot dry weight was about 20.67 and 19.66 % for *cv* Abees over *cv* Beauregard in the 1st and 2nd seasons, respectively.

The differences between sweet potato cultivars could be attributed to genetic differences between cultivars. Differences among sweet potato cultivars also observed by Al-Easily (2002), Ayoub, (2005) and Mandour (2005).

b. Effect of both methods and rates of K_2O application

The obtained results in Table (2) indicate also that, plant growth traits were significantly affected by both methods and rates of K_2O application. Fertilization of sweet potato grown in sandy soil with 50% of (RR) recommended rate of K_2O as soil application (SA) combined with K_2O at 3% as foliar application (FA) gave the tallest plants and recorded the maximum values of number of branches/ plant, leaf area and shoot dry weight / plant, followed by fertilization with 100 % RR of K_2O as SA in both seasons. The increases in shoot dry weight were about 80.95 and 111.87 % for 50 % RR of K_2O as SA + 3 % K_2O as FA and 75.41 and 92.01 % for 100 RR of K_2O as SA over 50 % RR of K_2O as SA combined with K_2O at 1 % as FA in the 1st and 2nd seasons, respectively. These treatments increased number of branches/plant which in turn increased dry weight of sweet potato shoots. Also potassium plays a vital role in photosynthesis.

The stimulative effect of 50 % RR of K_2O as SA combined with K_2O at 3 % as FA or 100 % K_2O as SA might be due to carotenoids (as atioxied) which led to increase in leaf area/ plant (Table 2) which in turn actived photosynthesis apparatus. And consequently had high efficiency of activation photosynthetic pigments to gave high photosynthesis and in turn more dry matter.

Advantages of foliar sprays with element nutrients are: (1) application rates much lower than for soil application, (2) a uniform application is easily obtained, and (3) response to the applied nutrient is almost immediate so deficiencies can be corrected during the growing season (Mortvedt *et al*., 1991).

Obtained results are coincided with these reported by Bourke (1985), George *et al.* (2002), El-Hadidi and Mansour (2008) and Abd El-Baky *et al*. (2010) on sweet potato. Also, El-Morsy *et al*. (2004) on garlic, El-Bassiony (2006) on onion and Gunadi, (2009) on potato.

Table 2

c. Effect of the interaction

It can be seen from data in Table (3) that, the interactions between cultivars and both method and rate of K_2O application reflected a significant differences on plant growth of sweet potato. Fertilization of *cv* Abees with 100 % RR of K_2O as SA was the best interaction treatment for enhancing vine length, number of branches / plant, leaf area, whereas fertilization with the same cultivar with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA was the best treatment for enhancing shoot dry weight/ plant. Whereas, fertilization of *cv* Beauregard with 50 % RR of K_2O as SA combined with K_2O at 1 % as FA gave the minimum value of shoot dry weight/ plant.

The increases in shoot dry weight, concerning *cv* Beauregard, were about 73.13 and 190.29 % when fertilized with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA, and 75.58 and 153.66 % when fertilized with 100 % RR of K_2O as SA over Beauregard with 50 % RR of K_2O as SA combined with K_2O at 1 % as FA in the 1st and the 2nd seasons, respectively. As for *cv* Abees the increasers in shoot dry weight were about 85.94 and 66.66 % with 50 % RR of K_2O as SA combined with K_2O at 3 % as FA, and 76.98 and 56.45 % with 100 % RR of K_2O as SA over Abees with 50 % RR of K_2O as SA combined with K_2O at 1 % as FA in the 1st and the 2nd seasons, respectively. It was also found differences among four sweet potato cultivars regarding leaf area under different levels of N and K (Nin and Gilsanz, 1998).

2. Photosynthetic Pigments

a. Effect of cultivars

The obtained results in Table (4) show that, there were insignificant differences between cvs Beauregard and Abees for chlorophyll a, b and total (a+b), except chlorophyll b in the 2nd season. On the other hand, there were significant differences between cvs Beauregard and Abees in carotenoids concentration where *cv* Beauregard gave higher concentration of carotenoids in leaf tissues than *cv* Abees.

b. Effect of both methods and rates of K_2O application

It is clear from data in Table (4) that the both methods and rates of K_2O application exerted a marked significant effect of photosynthetic pigments of sweet potato leaves. Application with 100 % RR of K_2O as SA or 50 % RR of K_2O combined with K_2O at 3 % as FA were the superior treatments for enhancing the concentrations of chlorophyll a, b, total (a+b) as well as carotenoids in the leaf tissues of sweet potato grown in sandy soil.

Potassium is a part of many important regulatory roles in the plant. It is essential in nearly all processes needed to sustain plant growth and reproduction; i.e. photosynthesis translocation of photosynthates, protein synthesis, control of ionic balance, regulation of plant stomata, turgor maintenance, stress tolerance and water use, activation of plant enzymes and many other processes (Cakmak, 2005).

Table 3

Table 4

c. Effect of the interaction

It is obvious from data in Table (5) that the interactions between cultivars and both methods and rates of K_2O application had significant effect on chlorophyll a, b and total (a+b) as well as carotenoids in the leaf tissues of sweet potato plants. Fertilization of cvs Beauregard or Abees with 100 % RR of K_2O as SA or with 50 % RR of K_2O combined with K_2O at 3 % as FA recorded the highest concentrations of chlorophyll a, b and total (a+b) in the leaf tissues in both seasons , whereas application of 100 % RR of K_2O as SA or 50 % RR of K_2O combined with K_2O at 3 % as FA recorded the highest concentration of carotenoids in the leaf tissues of *cv* Abees only.

3. Concentrations and uptake of N,P and K in shoots

a. Effect of cultivars

There were no significant differences between cvs Beauregard and Abees for N, P and K contents in their shoots, whereas, there were significant differences between them in uptake of N, P and K by their shoots. Cultivar Abees recorded higher N,P and K uptake by shoots than *cv* Beauregard in both seasons (Table 6). These differences in N,P and K uptake by shoots between the two cultivars were mainly due to heredity differences in their growth parameters.

b. Effect of both methods and rates of K_2O application

It is obvious from the obtained results in Table (6) that both methods and rates of K_2O application exerted a significant effect on N,P and K contents and their uptake by shoots of sweet potato plants. Fertilization of sweet potato plants grown in sandy soil with 100 % RR of K_2O as SA or with 50 % RR of K_2O combined with K_2O at 3 % as FA were the superior treatments for increasing of N,P and K contents and their uptake in shoots with few exceptions. 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). Therefore potassium contents in sandy soils was about 5.3 and 5.9 ppm in the 1^{st} and 2^{nd} seasons, respectively (Table1). These results are in harmony with those obtained by Abd El-Baky *et al*. (2010) on sweet potato and El-Morsy *et al*. (2004) on garlic.

c. Effect of the interactions

It is evident from the results in Table (7) that N,P and K contents and their uptake by shoots significantly affected by the interactions between cultivars and both methods and rates of K_2O application in the both seasons. In general , fertilization of *cv* Abees plants grown in sandy soil with 100 % RR of K_2O as SA or with 50 % RR of K_2O combined with K_2O at 3 % as FA

Table 5

Table 6

Table 7

were the best interaction treatments for increasing N,P and K contents and their uptake in shoots with few exceptions. Considerable variation in efficiency of K uptake and utilization has been identified among existing genotypes for a variety of crops species including sweet potato (George *et al*., 2002).

From foregoing results, it could be concluded that, fertilization of sweet potato grown in sandy soil with 50 % RR as SA +K_2O at 3% as FA or 100 % K_2O SA allows plants to grow better through enhancing photosynthetic product (Table 4), encourage plant growth, increase N,P and K uptake by shoots and consequently exhibited an increase in the dry weight of shoots (Table 3).

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استجابة بعض أصناف البطاطا لطرق ومعدلات إضافة البوتاسيوم تحت ظروف الارض الرملية
٢- النمو الخضرى والمحتوى الكيماوى للنبات

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الملخص العربي

أجرى هذا البحث خلال الموسمين الصيفين المتتاليين لعامى ٢٠٠٨ ، ٢٠٠٩ بمزرعة محطة بحوث البساتين بالقصاصين ، بمحافظة الاسماعلية ، ويهدف الى دراسة استجابة نباتات البطاطا لطرق ومعدلات إضافة البوتاسيوم (إضافة أرضية وإضافة عن طريق الرش) على النمو الخضرى والمحتوى الكيماوى لنبات بعض أصناف البطاطا (بيوروجارد وأبيس) تحت ظروف الأرض الرملية وباستخدام نظام الرى بالتنقيط ، وكانت النتائج كما يلى :

(١) أوضحت النتائج أن الصنف أبيس أعطى أعلى القيم لطول الفرع الرئيسى وعدد الأفرع للنبات والمساحة الورقية للنبات والوزن الجاف لعرش النبات وكذلك محتوى العرش من النيتروجين والفوسفور والبوتاسيوم ، بينما سجل الصنف بيوروجارد أعلى تركيز للكاروتينات فى أنسجة الورقة .

(٢) أعطى تسميد البطاطا فى الأرض الرملية بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% أعلى القيم لصفات طول الفرع الرئسى

وعدد الأفرع للنبات والمساحة الورقية للنبات والوزن الجاف لعرش النبات ومحتوى أنسجة الورقة من كلوروفيل أ و ب والكلوروفيل الكلى والكاروتينات ، وكذلك محتوى العرش من كل من النيتروجين والفوسفور والبوتاسيوم والممتص منهم بواسطة نباتات البطاطا.

(٣) تشير النتائج إلى أن أفضل معاملة تفاعل لطرق ومعدلات إضافة البوتاسيوم كانت عند تسميد الصنف آبيس بمعدل ٥٠% من الموصى به من بو٢أ إضافة أرضية + رش النباتات باستخدام بو٢أ بتركيز ٣% والتى أعطى أكبر زيادة في كل من (الوزن الجاف للعرش ومحتوى الورقة من الكاروتينات وكذلك محتوى العرش من كل من النتروجين والفوسفور والبوتاسيوم والممتص منهم).

Table 2: Effect of both methods and rates of potassium application on growth of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Characters / Treatments	Vine length (cm)		Number of branches/ plant		Leaf area/ plant (m^2)		Shoots dry weight/plant (gm)		Relative shoot dry weight (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Effect of cultivars										
Beauregard	123.27	123.13	12.49	11.56	0.632	0.456	90.51	62.93	100.00	100.00
Abees	129.09	128.12	39.77	24.01	0.848	0.690	109.22	75.30	120.67	119.66
LSD at 0.05 level	2.98	4.80	4.19	2.37	0.024	0.035	0.60	0.60	--	--
K_2O as SA+ FA	**Effect of methods and rates of K_2O application**									
100 %RR + 0%	129.33	134.10	32.82	22.14	1.006	0.712	119.67	80.84	175.41	192.01
50 %RR + 1%	108.15	116.85	18.27	14.23	0.504	0.489	68.22	42.10	100.00	100.00
50 %RR + 2%	133.21	118.26	21.18	14.71	0.500	0.403	88.14	64.32	129.19	152.77
50 %RR + 3%	134.02	133.29	32.25	20.05	0.949	0.687	123.45	89.20	180.95	211.87
LSD at 0.05 level	2.15	٣.٤٥	3.01	١.٧٢	0.017	٠.٠٢٥	3.97	١.٥٤	--	--

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 interactions between both methods and rates of potassium application on growth of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Treatments / Character		Vine length (cm)		Number of branches/ plant		Leaf area/ plant (m^2)		Shoots dry weight/plant (gm)		Relative shoot dry weight (%)	
CVS	K_2O as SA+ FA	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Beauregard	100 %RR + 0 %	120.93	124.97	14.23	12.28	0.751	0.448	109.13	78.13	173.58	253.66
	50 %RR + 1%	107.67	121.02	9.70	11.32	0.511	0.468	62.87	30.80	100.00	100.00
	50 %RR + 2%	133.86	110.90	8.73	9.38	0.377	0.418	79.96	53.38	127.18	173.31
	50 %RR + 3%	130.63	135.64	17.30	13.26	0.889	0.489	110.11	89.41	175.13	290.29
Abees	100 %RR + 0 %	137.74	143.24	51.41	32.01	1.261	0.976	130.21	83.56	176.98	156.45
	50 %RR + 1%	108.64	112.68	26.84	17.14	0.498	0.510	73.57	53.41	100.00	100.00
	50 %RR + 2%	132.57	125.62	33.63	20.05	0.623	0.388	96.32	75.26	130.92	140.90
	50 %RR + 3%	137.42	130.94	47.21	26.84	1.010	0.885	136.80	88.99	185.94	166.66
LSD at 0.05 level		3.05	4.86	4.25	2.43	0.024	0.033	5.60	2.18	--	--

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 4: Effect of both methods and rates of potassium application on Photosynthetic pigments in leaves of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Characters / Treatments	Photosynthetic pigments (mg/gm DW)						Carotenodes (mg/gm DW)	
	Chl. a		Chl. b		Total Chls. (a+b)			
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	Effect of cultivars							
Beauregard	2.47	2.96	2.16	2.08	4.63	5.05	3.61	3.44
Abees	2.61	2.94	2.45	2.46	5.06	5.40	2.88	2.84
LSD at 0.05 level	NS	NS	NS	0.18	NS	NS	0.22	0.45
K_2O as SA + FA	Effect of methods and rates of K_2O application							
100 %RR + 0 %	2.89	3.29	2.62	2.43	5.51	5.72	3.65	3.31
50 %RR + 1%	1.82	2.39	1.79	2.10	3.61	4.49	2.79	2.87
50 %RR + 2%	2.80	2.83	2.08	2.18	4.88	5.01	3.21	3.04
50 %RR + 3%	2.66	3.29	2.73	2.38	5.39	5.67	3.33	3.33
LSD at 0.05 level	0.30	0.17	0.21	0.12	0.43	0.34	0.16	0.32

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 the interactions between both methods and rates of potassium application on photosynthetic pigments in leaves of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Treatments / Characters		Photosynthetic pigments (mg/gm DW)						Carotenodes (mg/gm DW)	
		Chl. a		Chl. b		Total Chls. (a+b)			
CVS	K_2O as SA+ FA	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Beauregard	100 %RR + 0 %	2.65	3.31	2.53	2.32	5.18	5.62	3.86	3.70
	50 %RR + 1%	2.02	2.10	1.55	1.87	3.57	3.97	3.28	2.93
	50 %RR + 2%	2.91	3.01	1.84	1.91	4.75	4.92	3.69	3.42
	50 %RR + 3%	2.32	3.44	2.74	2.25	5.05	5.69	3.61	3.72
Abees	100 %RR + 0 %	3.13	3.28	2.71	2.54	5.84	5.82	3.45	2.92
	50 %RR + 1%	1.63	2.69	2.03	2.34	3.66	5.02	2.30	2.82
	50 %RR + 2%	2.69	2.65	2.33	2.45	5.01	5.10	2.74	2.67
	50 %RR + 3%	3.01	3.14	2.73	2.52	5.73	5.66	3.05	2.95
LSD at 0.05 level		0.42	0.24	0.30	0.18	0.61	0.48	0.22	0.45

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 both methods and rates of potassium application on N,P and K contents and its uptake in shoot of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Characters / Treatments	Mineral contents in shoots (%)						Mineral uptake by shoots					
	N		P		K		N		P		K	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	Effect of cultivars											
Beauregard	2.75	3.18	0.507	0.457	2.20	2.44	2667.5	2137.2	473.9	294.4	2075.3	1621.1
Abees	3.03	3.02	0.502	0.465	1.90	2.59	3587.0	2409.0	576.2	364.5	2230.6	2045.0
LSD at 0.05 level	NS	0.13	NS	NS	NS	NS	357.9	95.65	29.1	29.20	NS	121.05
K_2O as SA + FA	Effect of methods and rates of K_2O application											
100 %RR + 0 %	3.29	3.51	0.520	0.485	2.27	2.76	4117.3	2925.4	640.4	403.9	2792.1	2308.1
50 %RR + 1%	2.21	2.57	0.470	0.425	1.78	2.23	1560.7	1105.9	328.8	183.1	1239.6	968.3
50 %RR + 2%	2.51	2.79	0.495	0.495	1.89	2.42	2277.0	1818.9	451.4	328.0	1706.4	1611.9
50 %RR + 3%	3.57	3.53	0.535	0.438	2.25	2.66	4553.8	3242.1	679.8	402.7	2873.7	2443.9
LSD at 0.05 level	0.25	0.09	0.012	0.011	0.20	0.10	300.1	68.0	24.3	15.4	176.2	101.0

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 the interactions between both methods and rates of potassium application on N,P and K contents and its uptake in shoot of some sweet potato cultivars grown in sandy soil at 110 days after transplanting during summer seasons of 2008 and 2009

Characters / Treatments		Mineral contents in shoots (%)						Mineral uptake by shoots					
		N		P		K		N		P		K	
CVS	K_2O as SA+FA	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Beauregard	100 %RR+ 0 %	2.85	3.55	0.520	0.450	2.41	2.62	3208.5	2859.6	581.6	362.5	2706.5	2109.6
	50 %RR + 1%	2.11	2.68	0.490	0.440	2.13	2.23	1370.4	850.0	316.2	139.8	1383.0	708.3
	50 %RR + 2%	2.58	3.12	0.510	0.500	2.04	2.36	2126.8	1718.8	422.1	273.8	1679.1	1297.1
	50 %RR + 3%	3.49	3.39	0.510	0.437	2.23	2.57	3964.1	3120.5	575.9	401.4	2532.6	2369.4
Abees	100 %RR+ 0 %	3.74	3.47	0.520	0.520	2.14	2.91	5026.2	2991.3	699.2	445.3	2877.7	2506.6
	50 %RR + 1%	2.31	2.47	0.450	0.410	1.44	2.23	1751.0	1361.9	341.3	226.4	1096.2	1228.3
	50 %RR + 2%	2.44	2.47	0.480	0.490	1.75	2.48	2427.2	1919.1	480.6	382.3	1733.7	1926.7
	50 %RR + 3%	3.65	3.67	0.560	0.440	2.28	2.75	5143.6	3363.7	783.8	404.0	3214.7	2109.6
LSD at 0.05 level		0.36	0.13	0.018	0.015	0.29	0.14	422.1	96.21	34.3	21.8	249.2	142.8

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