

Effect of foliar fertilizer (high in potash) on growth and yield of seven potato cultivars (*Solanum tuberosom L.*)

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Abstract :

An experiment was conducted out during 2009 to study the effect of spraying numbers (0, 2 and 4) of Alaska foliar fertilizer (N:12, P₂O₅ :12 , K₂O: 36 , Fe : 0.05% , Cu:0.005% , Mn: 0.03% , Zn: 0.01% , B: 0.02% , Mo: 0.003%) on growth and yield of 7 potato cvs. (Draga, Aladin, Elpaso, Kurado, Diseree, Provento, and Red Brown). Factorial experiment included 21 treatments arranged in Random Complete Bloke Design (RCBD) with 4 replications. Results showed that foliar fertilizer had a significant effect on plant height, tuber weight and total yield. Potato cvs differ in all studied parameters. High yields were obtained from Red Brown, Provento and Draga cvs. Interactions had a significant effect on the most studied parameters.

Key words: potatoes cultivars, High K foliar fertilizers.

تأثير رش السماد الورقي (عالي البوتاس) في نمو سبعة اصناف من البطاطا (*Solanum tuberosom L.*) وانتاجها

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الخلاصة

اجريت تجربة في الموسم 2009 لدراسة تأثير عدد مرات الرش (0 ، 2 ، 4) من السماد الورقي عالي البوتاس الاسكا الذي يحتوي (N:12, P₂O₅ :12 , K₂O: 36 , Fe : 0.05% , Cu:0.005% , Mn: 0.03% , Zn: 0.01% , B: 0.02% , Mo: 0.003%) في نمو وحاصل سبعة اصناف من البطاطا (Draga , Aladin , Elpaso , Kurado , Diseree, Provento و Red Brown). طبقت تجربة عاملية متضمنة 21 معاملة وفق تصميم القطاعات العشوائية الكاملة باربع مكررات . بينت النتائج ان التسميد الورقي عالي البوتاس كان له تأثير معنوي في ارتفاع النبات ، متوسط وزن الدرنة والحاصل الكلي للدرنات . ان الاصناف اختلفت في جميع الصفات المدروسة . اعلى حاصل نتج من الأصناف Red Brown ، Provento و Draga . وكان للتداخل تأثير معنوي في اغلب الصفات المدروسة .

INTRODUCTION :

Potato (*Solanum tuberosum L.*) is the fourth world crop after wheat, rice and maize, which has a production of nearly 324.49 million tons produced from about 20 million hectares (FAO, 2007). Therefore, it is considered as the most important tuber crop. Moreover, potato is an important vegetable and a good source of antioxidants (Chen, et

al, 2007). Potato is a major source of inexpensive energy; it contains high levels of carbohydrates and amounts of vitamins B, C and minerals (Muthoni and Nyamongo, 2009).

Although potato is quite adaptable to planting conditions and it is considered to be cultivatable in almost every climate and soil conditions, it has, as every culture, certain requirements for ecological conditions. Stability of a varieties features and preserving quality in different conditions has great importance; total and graded yield and quality factors are affected by cultivars and location (Tomasiewicz *et al.*, 2003, Haase *et al.*, 2005). Both yield and quality of potato are affected by cultivar, environmental conditions, and cultural practices. In trial with Burren, Arnova and Aladin cv., Burren was a superior in yield, but Arnova was super in tuber mean weight (Kadum, 2011).

Fertilizer application has important effects on the quality and yield of potato (Westermann , 2005). Uptake of fertilizer nutrients (NPK) by potato per unit area and time is high because of the rapid rate of early growth and tuber bulking. Thus, the advantages of foliar fertilizer application should be explored, such as the smaller fertilizer use (since foliar fertilization consists on supplying small amounts of nutrients directed to the leaves), lower cost, ease of application, good quality of fertilizers used and fertilizers readily soluble in water (Buck *et al.*, 2008). Foliar fertilization has potential for an important role in potato production.

Nitrogen supply plays an important role in the balance between vegetative and reproductive growth for potato (Alva 2004). Many previous studies have shown that fertilizer N applications can increase total and/or marketable tuber yield (Kara 2002; Zebarth *et al.*, 2004; Zelalem *et al.*, 2009). It is suggested that late application of N in foliar sprays can be benefit to potato crop with a long growing season and reduce environmental losses of N.

Phosphor application significantly increased plant height, marketable tuber yield and marketable tuber number (Zelalem *et al* 2009). One of the major problems in the use of phosphate fertilizer is the fixation of applied phosphate by the soil and however, the efficiency of P uptake from fertilizer is low. Soluble phosphate applied to the soil loses its solubility almost immediately on coming in contact with the soil, as a result its availability to the planted crop is greatly reduced (Jenkins and Ali, 2000; Ali *et al.*, 2004). The foliar- P application resulted in higher tuber yield (Ekelöf, 2007).

Potassium is well documented in photosynthesis, increasing enzyme activity, improving synthesis of protein, carbohydrates and fats, translocation of photosynthetic, enabling their ability to resist pests and diseases. Also, potassium is considered as a major osmotic active cation of plant cell (Mehdi *et al.*, 2007) where it enhances water uptake and root permeability and acts as a guard cell controller, beside its role in increasing water use efficiency (Zekri and Obreza, 2009). Potato plants require much more potassium than many other vegetable crops (Al-Moshileh and Errebi, 2004). Application of K increases plant height and crop vigor. It increases both the rate and duration of tuber bulking. Its application assists in the translocation of carbohydrates from leaves to tubers.

Potassium increases the size but not the total number of tubers (Trehan *et al.*, 2001). Foliar application of K increased potato tuber yield. The increasing of foliar K fertilizer rates (2.5%) was associated with the highest yield (Habib et al, 2011). Foliar application of micronutrients has been one of the approaches to achieve an improvement the nutritional status, yield of potato end to optimize use of chemical fertilizers (Khalifa et al 2003). Potato plants foliar treated with Unigreen (containing macro and micronutrients) 2.5 g/l and Solu Potash (50% K₂O) 3.0 g/l gave higher total yield and higher number of marketable tubers per plant and total number of tubers per plant (Abdul Rasool *et al*, 2010). Foliar treated of potato plants with humus gave higher number of stems, plant height, mean tuber weight and total yield (Kadum, 2011).

The present investigation aimed to study the response of 7 Potato cultivars to the number of foliar fertilizer sprays.

Materials and Methods :

A field experiment was carried out on a farm 15 km south of Hilla , during 2009 to study the effect of spraying numbers (0, 2 and 4) of Alaska foliar fertilizer (N:12, P₂O₅:12 , K₂O: 36 , Fe : 0.05% , Cu:0.005% , Mn: 0.03% , Zn: 0.01% , B: 0.02% , Mo: 0.003%) on 7 potato varieties (Draga, Aladin, Elpaso, Kurado, Diseree, Provento, and Red Brown) obtained from Nahar Alawrad Company. Factorial experiment included 21 treatments arrangement in Random Complete Bloke Design (RCBD) with 4 replications. Potato seed Tubers were sown on 6 Feb. at 25 cm apart in the rows. Each plot consisted of 3 rows, each of five meters in length and 70 cm wide. The plot area was 10.5 m. DAP fertilizer was added at the rate of 200 kg/ha dressing 10 cm bellow the tubers. The first foliar spray was made after 40 days, in which plants were blossoming and were at the early tuber set stage. The other foliar sprays were made at weakly intervals. Plant length (cm), number of shoots was determined at 90 days after planting. At harvesting (21 May), fresh tuber yield were recorded in terms of number of tubers per plant and tuber weight as well as total yield.

The obtained data were subjected to the analysis of variance procedure and treatment means were compared to the L.S.D. test according to Al-Rawe and Kalaf- Allah, 2000.

Results and discussion :

Data presented in Table (1) showed that, length of potato plants were significantly increased as a result of plant spraying with Alaska fertilizer compared with the control treatment. In addition, there were no significant differences between 2 or 4 foliar times of sprays. The increases in plant height may be due to the role of such macro and micro nutrients in the physiological process and cell division and elongation which indirectly affect tissue formation and consequently vegetative growth of plant. These results are in good accordance with those obtained by Khalifa *et al* 2003; Abdul Rasool *et al*, 2010 and Kadum, 2011.

The varieties had a significant effect in plant height. It appeared that it was related to type of various varieties, (Tafi et al 2010). The interaction had a significant effect also.

Table (1) Effect of varieties and foliar high-K fertilizer number on plant height (cm)

Var.	control	2 time spray	4 time spray	Average var.
Draga	59	66	68	64.3
Aladin	50	56	63	56.3
Elpaso	62	68	67	65.7
Kurado	46	59	62	55.7
Diseree	51	68	69	62.7
Provento	54	72	69	65.0
Red Brown	49	59	61	56.3
Average of spray	53	64	65.6	

L.S.D. _{0.05} var. = 3.1

fertilizer = 2.03

interactions = 5.37

Results in table 2 showed that foliar fertilizer had no significant effect on stem numbers. Potato varieties had a significant effect on stem numbers, and Elpaso had the largest than other cultivars, it gave 4.6 stem which reached significant only with Aladin that gave 4.0 cm. In fact the stem numbers are formed after planting and before adding foliar fertilizer and cannot affect by it. It can be mentioned that the stem number in different cultivars is as one of the internal and compatible characteristics affected by the plant environmental condition (Henricksen and Molgaard, 2005).

Table (2): Effect of varieties and foliar high-K fertilizer number on stem numbers.

Var.	control	2time spray	4 time spray	Average var.
Draga	4.2	4.4	4.2	4.27
Aladin	3.7	4.1	4.2	4.00
Elpaso	4.4	4.7	4.7	4.60
Kurado	4.4	4.1	4.3	4.27
Diseree	3.9	4.2	4.4	4.17
Provento	4.0	4.6	4.3	4.30
Red Brown	4.1	3.9	4.2	4.17
Average of spray	4.1	4.3	4.3	

L.S.D. _{0.05} var. = 0.43

fertilizer = 0.28

interactions = 0.74

Foliar fertilizer caused an increase in tuber weight as compared with control (table 3). Four times of foliar fertilizer had no significant effect on this parameter as compared with two times. It may be attributed to the increase in vegetative growth by fertilizer and in the role of potassium in translocation of produced photosynthetic assimilates and its accumulation in storage organs (Habib et al 2011). Haeder et al (1973) indicated that with adequate K nutrition two thirds of the labeled photosynthesis product passed within one

day into the tubers when after flowering intensive growth of tubers set in. With insufficient K supply only half of the photosynthesis product was translocated to the tubers during the same period

Draga and Aladin varieties were superior in this parameter as compared to other varieties. It may be a variety characters. The interactions had a significant effect and Draga + 4 time sprayed was significant as compared with all interactions.

Table (3): Effect of varieties and foliar high-K fertilizer number on tuber weight(gm)

Var.	control	2 time spray	4 time spray	Average var.
Draga	65.0	71.9	76.8	71.2
Aladin	64.0	63.4	63.4	63.6
Elpaso	57.5	60.6	59.0	59.0
Kurado	56.6	56.0	58.2	57.0
Diseree	56.6	58.9	56.5	57.3
Provento	59.6	57.2	56.8	57.8
Red Brown	57.5	59.9	62.9	60.1
Average of spray	59.6	61.1	62.0	

L.S.D. _{0.05} var. = 2.52

fertilizer = 1.65

interactions = 4.37

Foliar fertilizer caused a significant effect on yield as compared with the control (table4). It could be concluded that increasing productivity of potato plants as a result of foliar fertilizer, may be due to increased in weight and numbers of tuber/plant which in turn increased the total tubers yield (ton/h.). This effect might be due to that potassium plays an important role in the transport of assimilates and nutrients (Allison *et al* 2001) as well as the enhanced effect of other materials contents of the fertilizer. These findings were supported by previous investigators such as Habib, *et al* 2011, El-Sirafy, *et al* 2008. The interactions had a significant effect and Draga + 4 time sprayed gave the highest, which differed significantly as compared with Aladin and Elpaso interaction. These results agreed with Kadum, 2011.

Table (4): Effect of varieties and foliar high-K fertilizer number on tuber yield (ton/h)

Var.	control	2 time spray	4 time spray	Average var.
Draga	21.398	30.045	29.553	27.999
Aladin	16.894	25.094	23.693	21.873
Elpaso	18.049	22.022	21.737	20.602
Kurado	19.304	24.640	26.265	23.403
Diseree	18.357	27.297	25.975	23.829
Provento	20.320	24.525	25.595	23.480
Red Brown	17.718	27.666	26.9654	24.116
Average of spray	18.959	25.899	25.683	

L.S.D. _{0.05} var. = 2.543

fertilizer = 1.665

interactions = 4.403

It can be conclude that spray potato plants with fertilizer contain high potash, led to improve growth and production of tubers per unit area, and it can also recommend that planting Red Brown, Provento and Draga varieties in south region of Babylon Governorate.

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