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RESPONSE OF FOUR POTATO CULTIVARS TO SPRAYING TREATMENTS OF KALMAK FERTILIZER

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Abstract

A field experiment was conducted in Al Mahaweel area-Babil Governorate in the autumn season 2018-2019 to study the response of four potato cultivars (Burin, Arizona, Safra and Ivor) to five foliar treatments with Kalmak fertilizer (nitrogen 10%, calcium 15%, magnesium 2%, humic 10%, boron 0.25%) at 5 and 10 ml L^{-1} and ascorbic acid at 25 and 50 mg L^{-1} as well as control. The spray was twice starting from 45 days after planting (tuber formation phase) and the second spraying at 15 days after the first spray (tuber expansion phase) until completely wet. The results showed that Burin cultivar was superior in plant yield (520.5 g), marketing yield (30.85 t ha^{-1}) and plant tubers number (6.31). Spraying 25 mg L^{-1} of ascorbic acid was superior plant tubers yield (554.0) and plant tubers number (6.38).

Key words: potato cultivars, foliar fertilizer, ascorbic acid.

Introduction

Potato *Solanum tuberosum* L. is one of the most important vegetable crops in the world. The area planted with potatoes in Iraq reached 6150 hectares in 2018 which produced 165.6 thousand tons with an average yield of 26.976 t ha^{-1} (Annual Statistical Abstract, 2018). The production of this crop is influenced by many factors, including the suitable cultivar, climatic and soil factors and the fertilization comes first (Bahash, 2006). Foliar fertilization is one of the most important methods of additional processing with plant nutrients and maintaining the nutritional balance within the plant. Potato tuber formation stage is the critical stage. As the tubers become larger, nutrient reservoir and the available stock of food in the vegetative or absorbed parts of the soil may be insufficient, so it requires nutrients to absorb in easy and quickly way. The addition of fertilizers should be balanced because the excessive caused degradation and pollution of natural resources and production (Havlin *et al*., 2005). In a study conducted in Ethiopia on 26 potato genotypes, Mohammed and Burgel, (2015) observed significant differences between genotypes and the genotype Al. 270 was exceeded in plant tubers number (9 tubers), while the genotype Vivadil recorded the highest tubers yield (24.3 t ha^{-1}). Khalil and Al-Othman in Mosul found that Madeleine cultivar was superior as compared to Rivera and Santa cultivars in plant tubers number and yield (10.54 tubers, 628.9 g per plant and 21.632 t ha^{-1}). Bilate and Mulualem (2016) found in their study on 16 potato genotypes that there were significant differences between the genotypes in growth and yield. Abo-Hinna and Merza, (2012) found that spraying ascorbic acid caused significant increase in tuber marketable yield compared to control treatment. Radhi, (2016) fount that spraying of ascorbic acid caused significant increase in tomato yield.

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Materials and Methods

The experiment was carried out during the autumn season 2018-2019 in Mahaweel district, north of Babylon governorate, in loam clay soil (Table 1).

The experiment included four potato cultivars (Burien, Sivra, Arizona and Ivor) and five spraying treatment of Kalmak fertilizer (nitrogen 10%, calcium 15%, magnesium 2%, humic 10%, boron 0.25%) at 5 and 10 ml L^{-1} and ascorbic acid at 25 and 50 mg L^{-1} as well as control. Randomized complete block design with three replications was used. The soil was prepared and 400 kg ha of compound fertilizer (NPK, 20-20-20) was added, then it was divided into three replicates. Each experimental units included four ridges 75cm apart and 2.5m long (7.5m2). Potato tubers were planting at 17/9/ 2018 in

Table 1: Some chemical and physical properties the soil.

Character	Unit and value	Character		Unit and value
pH	7.7	Soil separating	sand	243.6 g kg^{-1}
Ec	4.10 dS m^{-1}		loam	452.2 g kg^{-1}
Available N	36.8 mg kg^{-1}		clay	304.2 g kg^{-1}
Available P	8.6 mg kg^{-1}	Soil texture		Clay loam
Available K	82.4 mg kg^{-1}	Organic matter		2.12

hills 25 cm apart and 15 cm depth on the top of the ridges. After 50 days urea at 50 kg ha^{-1} was added. Spraying was done twice at 45 days after planting and 15 days later. Plant and soil management was done according to (Matlob *et al*., 1989). The plants were harvested at 10/1/2019.

Results and Discussion

Table 2, showed that cultivars was significantly differ in plant tubers number and burein cultivar achieved the highest tubers number (6.31 tubers $plant^{-1}$), while Arizona (v2) achieved the lowest number (5.96). This is due to the genetic variations of the cultivars and their gene expression within the environmental conditions prevailing in the region (Haile, 2009). Spraying treatments caused a significant effect on plant tubers number. Spraying of ascorbic acid at 25 ml L^{-1} achieved the highest number (6.38 tubers $plant^{-1}$), while the other treatments were not significantly different from control treatment. This is due to the effect of ascorbic acid, which created a state of equilibrium that increased plant efficiency and improved its nutritional status, which appeared in tubers quality (Amran, 2004 and Khan *et al.*, 2011). As well as that ascorbic acid is an antioxidant that protects the chloroplasts from oxidation and thus delays leaves aging, which increases the effectiveness of this process and its products (Smirnoff, 1996; Chen, 2002; Hussein, 2011).

Table 3, shows that cultivars were differed significantly in the average weight of tuber (g). Ivor cultivar was superior significantly in tuber weight (91.3 g) without differences from Sufra cultivar (90 g), while Burien cultivar gave the lowest mean (80.0 g). This may be because this trait is a genetic trait of the variety (Jasim *et al*., 2013; Fontes *et al.*, 2016). The results showed that spray treatments caused significant effect on this trait compared to control treatment. This may be due to the presence of organic acid (humic) and nutrients in the liquid fertilizer, which led to an increase in the plant's content of nutrients and thus stimulate growth and increase the effectiveness of carbon representation (Khan *et al*., 2011) and the strength of plant vegetative and root growth, which led to increase tuber weight (Mohsen and Alwan, 2019). As well as the role of boron effective in the transfer of photosynthesis products from source (leaves) to sink (tubers), which caused increases in tuber weight (Bari *et al.*, 2001 and Osman *et al.*, 3019). Ascorbic acid leads to improve growth through its effect in increasing photosynthesis, which leads to an increase in the amount of carbohydrates accumulated in plant tissues and increase the yield (Muthanna *et al*., 2017). Ascorbic acid has a role in increasing the efficiency of photosynthesis process by protecting the pigments and apparatus of this process from oxidation damage that occurs as a result of biological processes leading to an increase in the rate of carbohydrates (Al-asady and Alkhakani, 2019; Alayafi, 2019), as well as its role in the division and cell growth, which reflected in increasing tuber weight (Cheruth, 2009). The interaction between the factors caused significant effect on tuber weight. Ivor

Table 2: Effect of potato cultivars and spray treatments on plant tubers no.

Cultivars / Treatments	burein	Arizona	Safra	Igor	Spraying average
Control	6.10	6.10	6. 00	6.00	6.05
Galmic 5 ml L^{-1}	6.03	6.03	5.90	5.87	6.04
Galmic 10 ml L^{-1}	5.47	6.13	5.97	6.10	5.92
Ascorbic 25 mg L^{-1}	7.00	5.80	6.40	6.33	6.38
Ascorbic 50 mg L^{-1}	6.37	6.10	5.97	5.90	6.09
Cultivars average	6.31	5.96	6.05	6.04	
$LSD_{0.05}$	Cultivars= 0.30 interaction=0.70				0.36

Table 3: Effect of cultivars, spraying treatments on tuber weight (g).

Cultivars / Treatments	burein	Arizona	Safra	Igor	Spraying average
Control	63.4	80.1	95.7	84.0	80.8
Galmic 5 ml L^{-1}	78.3	83.1	82.0	80.0	80.9
Galmic 10 ml L^{-1}	85.0	94.7	96.6	95.1	92.8
Ascorbic 25 mg L^{-1}	80.7	85.3	86.5	101.9	88.6
Ascorbic 50 mg L^{-1}	92.8	91.0	89.0	95.7	92.1
Cultivars average	80.0	86.8	90.0	91.3	
$LSD_{0.05}$	Cultivars= 6.86 interaction=15.35				7.67

Table 4: Effect of cultivars, spraying treatments on plant yield (g).

Cultivars / Treatments	burein	Arizona	Safra	Igor	Spraying average
Control	482.5	437.5	371.2	416.3	426.9
Galmic 5 ml L^{-1}	507.8	470.0	424.6	473.2	468.9
Galmic 10 ml L^{-1}	556.2	498.6	432.5	443.2	482.6
Ascorbic 25 mg L^{-1}	540.4	562.9	502.7	610.0	554.0
Ascorbic 50 mg L^{-1}	515.9	525.9	447.1	633.2	530.5
Cultivars average	520.5	499.0	435.6	515.2	
$LSD_{0.05}$	Cultivars= 39.5 interaction=88.3				44.1

Table 5: Effect of cultivars and spraying treatments on marketing yield.

Cultivars / Treatments	burein	Arizona	Safra	Igor	Spraying average
Control	28.59	29.88	22.00	16.77	24.31
Galmic 5 ml L^{-1}	30.09	23.90	25.16	28.04	26.80
Galmic 10 ml L^{-1}	32.96	29.55	23.54	29.07	28.78
Ascorbic 25 mg L^{-1}	32.02	33.35	29.80	36.15	32.83
Ascorbic 50 mg L^{-1}	30.57	31.16	22.15	37.52	30.35
Cultivars average	30.85	29.57	24.53	29.51	
$LSD_{0.05}$	Cultivars= 0.152 interaction=ns				0.170

cultivar *25 mg L^{-1} ascorbic acid achieved the highest tuber weight (101.9 g), while Burien cultivar at control achieved the lowest tuber weight (63.4 g).

Table 4, showed that cultivars were differed significantly in plant tubers yield (g). Burein and Ivor cultivars was superior and achieved the highest plat tubers yield (520.5 and 515.2 g, respectively). While Sufra cultivar achieved the lowest plant tubers yield of 430 g. This result was due to the genetic differences between the cultivars and the effect of environmental conditions on gene expression (Jasim *et al*., 2013). Table 4, also showed that spraying treatments caused significant effect on plant tubers yield compared to control treatment. Ascorbic acid spraying in at 25 and 50 ml L^{-1} achieved high plant tuber yield (530.5 and 554.0 g, while control treatment achieved the lowest average plant yield (426.9 g). The effect of ascorbic acid on potato tubers productivity may be attributed to its effect in increasing nutrient abundance and preservation of chlorophyll from oxidative (Hammam *et al.*, 2001), which reflected in increasing plant tuber yield.

Table 5, showed that cultivars were significantly differ in marketing yield. Burien cultivar achieved significantly highest marketing tuber yield (30.85 t ha^{-1}) compared to other cultivars, while Sufra achieved the lowest marketing yield (24.53 t ha^{-1}). This result may be due to cultivars genetic differences and its interaction with the surrounding environmental conditions (Jasim *et al*., 2013 and Yadav *et al*., 2017). Table 5, also showed that spraying treatments caused significant effect on marketing yield compared to control treatment. Spraying 25 g L^{-1} of ascorbic acid achieved highest marketing yield (32.83 t ha^{-1}), while control treatment gave lowest yield (24.31 t ha^{-1}).

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