

## Impact of foliar application by urea phosphate and salicylic acid on the growth and seed yield of *Allium cepa* L.

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### Abstract

A field experiment was conducted in the agricultural season 2011-2012 in the vegetable field of the Department of Horticulture and Landscape Gardening – College of Agriculture - University of Baghdad to observe the impact of each salicylic acid and urea phosphate on the growth and seed yield of onion plant var. Texas Early Grano. The plants sprayed with different concentrations of salicylic acid (0,100,200 mg. L<sup>-1</sup>) (S0, S1, S2) and urea phosphate (urea 18%, P<sub>2</sub>O<sub>5</sub>44%) (0, 2.5,5 gm.L<sup>-1</sup>) (P0, P1, P2) until the complete wetness for four times at the beginning of each month, starting from 1<sup>st</sup> of December, the experiment was designed under factorial arrangement within RCBD (3X3X3).

The statistical analysis showed the significant results of the sole factors. S2 treatment gave the highest numbers in Umbel's diameter and Setting percent (7.789 cm) (78%) respectively. P2 treatment demonstrated more superiority in all the experiment parameters, such as plant seed yield and weight of 1000 seeds (28.42gm.) (3.889gm.) in sequence ,while the interaction treatments showed a distinct findings precisely S2P2 treatment which showed significant results in all parameters ,such as reducing the number of days required for seed maturity (day) germination vigor (210.3day) (80.33%).

تأثير التغذية الورقية بفوسفات اليوريا وحامض الساليسيك في نمو وحاصل بذور نبات البصل *Allium cepa* L.

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### المستخلص

نفذت تجربة حقلية في الموسم الزراعي 2011-2012 في حقول قسم البستنة وهندسة الحدائق في كلية الزراعة/جامعة بغداد بهدف دراسة تأثير كل من حامض الساليسيك بثلاث تراكيز (0،100،200 ملغم.لتر<sup>-1</sup>) رمز لها (G0)، وفوسفات اليوريا (يوريا 18% و P<sub>2</sub>O<sub>5</sub> 44%) بثلاث تراكيز أيضاً (0،2.5،5 غم.لتر<sup>-1</sup>) رمز لها (P1, P0)، وفي نمو وانتاجية بذور نبات البصل صنف تكساس ايرلي جرانو، رشّت النباتات حتى البلل التام لاربعة مرات ابتداءً من بداية شهر كانون الاول وكرر الرش في بداية كل شهر. (نفذت تجربة عاملية 3X3 وفق تصميم القطاعات الكاملة المعشاة RCBD وبثلاث مكررات).

اوضحت نتائج التحليل الاحصائي معنوية واضحة للعوامل المفردة، اذ اعطت معاملة S2 اعلى قطر للنورة واعلى نسبة عقد (7.789 سم) (78%) على الترتيب، كما تميزت معاملة P2 باعطائها نتائج افضل في الصفات المقاسة جميعها مثل حاصل النبات الواحد من البذور (28.42 غم) ووزن 1000 بذرة (3.889 غم)، في حين اعطت معاملات التداخل نتائج متميزة لاسيما معاملة S2P2 التي تفوقت معنوياً في المؤشرات جميعها مثل تقليل عدد الايام اللازمة لنضج البذور (210.3 يوم) وقوة الانبات (80.33%).

## Introduction

Onion plant *Allium cepa* L. is considered one of the most crucial and oldest crop in the world . It is consumed routinely everyday globally (Watt and Merrill ,1963). In addition to its medicinal importance as a rich source of antioxidant ,anti-inflammatory , antiseptic, anti-asthmatic and anti-diabetic plant (Ashwini and Sathishkumar,2014). Indeed, it has a distinct series of organic sulfur compounds which contribute in the mentioned activities besides lowering high blood pressure (Doktorgrades ,2007). Onion plant is biennial that requires two seasons to complete its life cycle (University of California, 2013 ; Nikus and Mulugeta, 2010) . As a result, Onion seed production process is ranked as the most complicated among the vegetable crops which needs high qualified people having complete knowledge about the plant nature and the optimum conditions to produce its seeds.

Foliar feeding has a great influence on nutrient uptake precisely when there is a lack in nutrients obtainability in the soil (Oosterhuis, 2009 ; Schlegel and Schonherr ,2002). Wojcik (2004) recommended foliar application in order to attain integral productivity particularly for the microelements and plant growth regulators. Salicylic acid (ortho-hydrobenzoic acid) which is drawn from cinnamic acid is a natural hormone that exist in most of plants (Alibert and Ranjeva, 1972 ). it has an explicit impact on plant growth, thermogenesis, flower induction, absorption of ions, leaf anatomy and chloroplast structure (Hayat and Ahmad, 2007). Khurana and Maheshwari (1979) found that salicylic acid promoted the flowering in on *Lemna paucicostata* plant. Another research which is done by Fariduddin et al (2003) showed that Salicylic Acid significantly impacted the

dry weight, photosynthetic rate, carboxylation efficiency, activities of nitrate reductase, the number of pods ,and finally the seed yield in mustard plant. moreover, Pacheco et al (2013) found that salicylic acid significantly affected the number of inflorescences in marigold plant.

Phosphorus has a major role on energy transferring (Taiz, et al. 2014). In addition, its regarded as a main component in many essential compounds in the plant ,such as, nucleic acids, ,phospholipids and nucleotides (Barker and Pilbeam, 2007).it has been evident by many researches that phosphorus affects flowering and setting in a large scale by fastening the arrival to flowering stage , increasing the number of flowers and stimulating the growth of pollen tube (Espinoza et al,1993; Ran, 2008; Qiu et al,2011; El-Naggar et al ,2009 ; Menary and Staden, 1976). Nitrogen is the most required element for the plant because it enters in the structure of many important components in the plant cells ,such as amino acids ,proteins and, nucleic acids. As a result, its deficiency inhibits the growth directly (Taiz, et al. 2014). As a result, the study aimed to observe the impact of each salicylic acid and urea phosphate on the growth and seed yield of onion plant.

## Material and methods

Bulb to seed method experiment was implemented in the agricultural season 2011-2012 in the vegetable field of the Department of Horticulture and Landscape Gardening – College of Agriculture - University of Baghdad. The bulbs var. Texas Early Grano that their diameter ranged from 4cm to 6cm planted on 1<sup>st</sup> of October on 2011. The plot had 24-plant within two rows (the row's length was 4.8cm) and distance 40cm between plant

and another. The distance between row and another was 75cm and total area of the plot was 7.2 m<sup>2</sup> . All the plots were fertilized according to the recommended dose of onion plant, the plants sprayed with different concentrations of salicylic acid (0,100,200 mg. L<sup>-1</sup>) (S0, S1, S2) and urea phosphate (urea 18% , P<sub>2</sub>O<sub>5</sub>44%) (0,2.5,5 gm.L<sup>-1</sup>) (P0, P1, P2) until the complete wetness. The spraying repeated four times at the beginning of each month, starting from 1<sup>st</sup> of December until March (AL-Khafagy, 2010), the umbels harvested at the end of May 2012 the experiment was

implemented under factorial arrangement within RCBD (3X3X3). The means compared with each other according to Dunkin multiple range test under 0.05 probability.

After tilling, softening and settling the soil, several samples took from the soil in depth (0-30 cm) and merged in one sample to analyze it in the laboratories of the Department of Soil and Water Science, College of Agriculture, University of Baghdad. Table 1 shows the chemical and physical properties of the soil from the field before planting.

**Table (1): physical and chemical properties of the field's soil.**

the character	the values
pH	7.3
EC	3.1dS.m <sup>-1</sup>
Carbonate metals	251 gm.kg <sup>-1</sup>
available nitrogen	31 mg.kg <sup>-1</sup>
available phosphorus	14.6 mg.kg <sup>-1</sup>
available potassium	22.31 mg.kg <sup>-1</sup>
sand	287 gm.kg <sup>-1</sup>
loam	563 gm.kg <sup>-1</sup>
clay	159 gm.kg <sup>-1</sup>
soil type	loamy

The following parameters were measured on five random plants from each plot:

1. The number of leaves/plant
2. Leaf area (ds<sup>2</sup>): its measured according to Gamieli et al (1991) method.
3. The dry weight of the bolter: five bolters were chose from different plants ,after that

they were cut and placed in the oven under 70° Celsius until the stability of the weight.

4. Umbel's diameter (cm): it measured by vernier at the flowers opening stage.
5. Setting percent (%): it was counted according to the following equation:

$$\text{Setting percent} = \frac{\text{the total set of the flowers in one umbel}}{\text{the total number of flowers in one umbel}} \times 100$$

6. Number of days required for reaching seed maturity: It calculated from planting till the maturity of 75% of the plot seeds.

7. Plant seed yield (gm.): it counted by weighting the seeds of each plant separately.
8. 1000 seeds weight (gm.): a random sample of seeds was taken from each

plot and it counted and weighted by seed counter device.

9. Germination vigor (%) : it counted after six days from culturing (first count) according to this equation:

$$\text{seed germination percent} = \frac{\text{the number of normal germinated seeds}}{\text{the total number of seeds}} \times 100$$

10. Quercetin concentration in the seeds: it was measured but we didn't gain any results.

## Result and discussion

### 1. number of leaves/plant ,leaf area (ds<sup>2</sup>) and the dry weight of the bolter (gm.)

Table 2 demonstrates the non-significant impact of salicylic acid on number of leaves/plant. However, salicylic acid impacted both of Leaf area and the dry weight of the bolter. The highest values was attained in S2 (26.61 ds<sup>2</sup>), (16.22 gm.) as a sequence, while the lowest values found in S0 (22.46 ds<sup>2</sup>), (13.89 gm.) successively.

**Table (2): the impact of urea phosphate and salicylic acid on some vegetative growth parameters**

parameters treatments	number of leaves/plant		Leaf area (ds <sup>2</sup> )		the dry weight of the bolter (gm.)	
S0	16.56	a	22.46	b	13.89	b
S1	16.78	a	24.21	a	16.22	a
S2	17.56	a	26.61	a	16.22	a
P0	16.00	b	19.57	c	12.67	c
P1	17.00	a	25.12	b	15.22	b
P2	17.89	a	28.59	a	18.44	a
S0P0	16.00	c	17.43	e	11.00	e
S0P1	16.67	abc	23.97	bcd	14.66	bc
S0P2	17.00	abc	25.97	abc	16.00	b
S1P0	15.67	c	19.47	de	12.67	ce
S1P1	16.67	abc	24.83	bcd	16.67	b
S1P2	18.00	ab	28.33	ab	19.33	a
S2P0	16.33	bc	21.8	cde	14.33	bc
S2P1	17.67	abc	26.57	abc	14.34	bc
S2P2	18.67	a	31.47	a	20.00	a
the means that have the same letters in each parameter, don't differ significantly						

Foliar feeding with urea phosphate showed a strong influence in all parameters that represented in table 2. The maximum numbers was found in P2 treatment (17.89 leaves/plant)

(28.59ds<sup>2</sup>) (18.44 gm.) respectively. The minimum numbers was found in P0 treatment (16.00 leaves/plant) (19.57 ds<sup>2</sup>) (12.67 gm.) respectively.

The results that obtained from the interaction between salicylic acid and urea phosphate clearly showed the significant predomination of S2P2 by giving the highest numbers in all parameters that mentioned in table 2 (18.67 leaves/plant) (31.47 ds2) (20.00 gm.) as sequence whereas S0P0 represents the lowest numbers (16.00 leaves/plant) (17.43 ds2) (11.00 gm.) respectively.

## 2. Umbel's diameter (cm), setting percent (%) and number of days required for seed maturity

The results that represented in table 3 reveal the superiority of S2 treatment by giving the maximum numbers in Umbel's diameter and setting percent (7.789 cm.) (78%) in sequence. Furthermore, it significantly reduced the number of days that needed for seed maturity (215.2 days), in comparing with S0 treatment which

gave the minimum numbers in Umbel's diameter and setting percent (6.4 cm.) (65%) in sequence and the highest number of days that required for seed maturity (223.3 days).

Table 3 also demonstrates the significant influence of P2 treatment on the mentioned parameters (7.800cm.) (78.89%) (212 days) in sequence, in compare with P0 treatment (6.378cm.) (62.11%) (225 days) successively.

The interaction between salicylic acid and urea phosphate demonstrates a remarkable results (table 3). S2P2 treatment excelled in all other interacted treatments in all the mentioned parameters in table 3 (8.4cm.) (84%) (210.3 days) in sequence in compare with the lowest results that attained from S0P0 treatment (5.5cm.) (71%) (234.3 days) respectively.

**Table (3): the impact of urea phosphate and salicylic acid on some flowering parameters**

parameters treatments	Umbel's diameter (cm)		Setting percent (%)		Number of days required for seed maturity (day)	
S0	6.400	c	65.00	c	223.3	a
S1	7.156	b	71.78	b	217.0	a
S2	7.789	a	78.00	a	215.2	b
P0	6.378	c	62.11	c	225.0	a
P1	7.167	b	73.78	b	218.5	b
P2	7.800	a	78.89	a	212	c
S0P0	5.500	d	71.00	d	234.3	a
S0P1	6.467	c	69.67	b	222.3	b
S0P2	7.233	b	71.33	b	213.3	def
S1P0	6.430	c	61.33	c	220.6	b
S1P1	7.267	b	72.67	b	218.0	bcd
S1P2	7.677	b	81.33	a	212.3	ef
S2P0	7.200	b	71.00	b	220.0	bc
S2P1	7.677	b	79.00	a	215.3	cde
S2P2	8.400	a	84.00	a	210.3	f
the means that have the same letters in each parameter, don't differ significantly						

### 3. plant seed yield (gm.) , weight of 1000 seeds (gm.) and Germination vigor (%):

The findings in table 4 clarify the significant response of onion plants to aqueous salicylic acid application (200 mg. L<sup>-1</sup>) by increasing the plant seed yield (27.97 gm.) and Germination vigor (70.33%), while the lowest values found in S0 treatment (22.33 gm.) (61.67%) respectively. However, the salicylic acid didn't affect significantly the weight of 1000 seeds.

Table 4 also shows the significant effect of foliar application with urea

phosphate (5 gm. L<sup>-1</sup>) which is represented in giving significant numbers in plant seed yield (28.42gm.) , weight of 1000 seeds (3.889 gm.) and Germination vigor (75.56%) in compare with lowest numbers that obtained from P0 treatment (21.94gm.) (3.422 gm.) (56.67%) respectively.

For interaction treatments, S2P2 maintains the maximum numbers in all parameters that mentioned in table 4 (30.25 gm.) (4.033 gm.) (80.33%) respectively, while the minimum numbers found in S0P0 treatment (18 gm.) (3.333 gm.) (49%) respectively.

**Table (4): the impact of urea phosphate and salicylic acid on plant seed yield (gm.) , weight of 1000 seeds (gm.) and Germination vigor (%)**

parameters treatments	plant seed yield (gm.)	weight of 1000 seeds (gm.)	Germination vigor (%)
S0	22.33 b	3.611 a	61.67 b
S1	25.94 a	3.656 a	68.89 a
S2	27.97 a	3.700 a	70.33 a
P0	21.94 c	3.422 c	56.67 c
P1	25.89 b	3.656 b	68.67 b
P2	28.42 a	3.889 a	75.56 a
S0P0	18.00 d	3.333 d	49.00 f
S0P1	22.83 c	3.733 abc	66.33 cde
S0P2	26.17 bc	3.767 abc	69.67 bcd
S1P0	22.83 c	3.433 cd	61.00 de
S1P1	26.17 bc	3.667 abcd	69.00 bcde
S1P2	28.83 ab	3.867 ab	76.67 ab
S2P0	25.00 bc	3.500 bcd	60.00 e
S2P1	28.67 ab	3.567 bcd	70.67 bc
S2P2	30.25 a	4.033 a	80.33 a
the means that have the same letters in each parameter, don't differ significantly			

It can be observed from this findings that the salicylic acid played a vital role in increasing the most of the experiment's

parameters and that may be attributed to its hormonal effect that targeted the plant growth and its parameters such as the leaf

area of the plant and that affectively contributed in increasing the green area that catches the sunlight. Therefore increasing the products accumulation of the photosynthesis and that led to build a strong plants have the ability to vernalize in effective way because onion plant won't respond to vernilization if it doesn't pass the juvenile period by building a large size of foliage (University of California, 2013). As well as, the influence of salicylic acid as a flowering promoter and its effect on changing the synthesis of many plant hormones such as jasmonic acid (Vlot et al, 2009). Accordingly, that's affected the other flowering and seed yield parameters.

As for the superiority of urea phosphate treatments that's due to the phosphorus element work in biosynthesis of the plant by its entrance in many crucial compounds in the plant ,such as, nucleic acids, ,phospholipids and nucleotides (Barker and Pilbeam, 2007). Hence, all the vegetative parameters are significantly improved and that enabled onion plant to utilize from the decreasing of temperature degrees to bloom early. Moreover, phosphorus increases the number of flowers and stimulates the growth of pollen tube (Espinoza et al,1993; Ran,2008; Qiu et al,2011; El-Naggar et al ,2009; Menary and Staden, 1976) . As a consequences, all the flowering and seed yield parameters are significantly improved. In addition to what mentioned, the nitrogen portion in urea phosphate played a cooperative role with phosphorus to achieve strong plants that have the ability to vernalize and bloom early due to its direct relationship with growth and chlorophyll formation (Taiz, et al. 2014).

The distinction of the interaction treatments may be due to the synergic work for salicylic acid and urea phosphate

to achieve maximum growth ,flowering, and seed yield parameters.

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