



## EVALUATION OF THE EFFICIENCY OF ONION (*Allium cepa* L.) SETS TREATED WITH ASCORBIC ACID AND SALICYLIC ACID IN STIMULATING GROWTH AND SEED PRODUCTION

Munira Mahdi Salih, Noura Kka

Department of Horticulture, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, Kurdistan Reign, Iraq

### ABSTRACT

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#### Correspondence Email:

[noura.kka@su.edu.krd](mailto:noura.kka@su.edu.krd)

Onion (*Allium cepa* L.) is one of the economical cultivated crops and is consumed heavily worldwide. The demand for onion seeds is high as it loses viability within a year. In Iraq, onion production has been limited due to the lack of good quality of seeds. Therefore, this study was aimed to improve seed quality and productivity of onion local white cultivar by using optimum onion sets size and priming with phytohormones. A field experiment was carried out in the Grrdarash field belonging to the Salahaddin University, Erbil. A split-plot in Randomized Complete Block Design (RCBD) was applied with three replicates. Onion sets >6.0 cm, large diameter and 4-6 cm, medium diameter, was selected. The bases of the sets were soaked in ascorbic acid (AsA) (1 and 2 mM), salicylic acid (SA) (0.5 and 1 mM) and control (water only) for 24 hours at 4°C. The results show that the emergence rate of flower stalk per day, the rate of umbel opening per plant, the number of flower stalks per plant, the number of flowers per umbel and seed yield (t.h-1) were increased statistically and significantly by using the large onion sets. AsA and SA treatments show their significant effect on flowering and seed quantity. A positive relationship was found between the aforementioned treatments and onion seed yield. Therefore, further studies are required to evaluate the effectiveness of a natural product that has the same properties as AsA and SA on the growth and quality of vegetable crops.

College of Agriculture and Forestry, University of Mosul.

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### INTRODUCTION

Seed production has a crucial role in agriculture and specifically, in vegetable seed production. Seed quality and purity is the target of the plant breeders and seed associations. Seed viability is the most concern for farmers and producers, economically and socially. Onion (*Allium cepa* L.) is the common bulb vegetable belonging to the Alliaceae family. Onion is consumed freshly and dried in Iraq and worldwide. In addition to the pungency, phytonutrients and antioxidant properties of the onion bulbs (Liguori *et al.*, 2017), onion seeds have diverse therapeutic applications for humans (Amalfitano *et al.*, 2019 and Borah and Banik, 2018). Furthermore, onion seeds have the lowest longevity among the vegetable crops, and their viability decreases sharply within a year, despite the genetic traits, agricultural

practices and storage conditions (Yalamalle *et al.*, 2020). In Iraq, Kurdistan Region, the area devoted to onion bulb and green onion production was six thousand hectares (Anonymous, 2019). Due to low productivity and lack of purity and viability of local onion seed in Iraq, the local farmers rely on imported hybrid onion seeds. However, efforts have been made to encourage farmers to produce seeds locally.

Seed production is the last stage of the plant life cycle, which influences by specific environmental requirements during vegetative and storage stages. Early flowering and a higher yield of onion seed are assisted by the proper vernalization temperature of mother onion bulbs (Khokhar, 2014). Vernalization is a technique that allows certain plant species, such as onion, to enter the reproductive stage by exposing them to cold but not freezing conditions (Streck, 2003). For example, a short-term cold treatment at 10°C for 10 days was improved seed development in onions (Yalamalle, 2016). The vernalization requirement for onion flowering (bolting) varies by cultivar and the duration time of exposure to low temperature (Khokhar, 2008).

The onion is a biannual plant propagated by seeds and bulbs. Selecting the method of propagation depends on environmental conditions, cultivar, agricultural practices and most importantly the purpose of cultivation. For example, in Iraq, it was shown that the best planting date for seed-to-seed production of onion is September (El-Habar and Kika, 2010). The bulb to seed method is producing seeds from mother bulb or sets, it has been shown that planting onion sets in late November was accelerated vegetative and seed yield in Bangladesh (Anisuzzaman *et al.*, 2009). In addition, selecting the appropriate size of onion sets may have an impact on seed quantity and quality, it has been studied and recommended that the onion sets size diameter (5.1 to 7.0 cm) yielded significantly higher seed yield when compared with the small sets (2-4 cm) (Ashenafi *et al.*, 2017; Khokhar, 2008).

Plant growth regulators are organic compounds other than nutrients that stimulate, inhibit, or otherwise alter any physiological response in plants when used in small amounts (Geetharani *et al.*, 2008). In plants, salicylic acid (SA) is a major protection agent against biotic and abiotic stresses and regulate plant growth and development (Carr *et al.*, 2010). In onions, SA appears to mitigate the effect of salt stress and enhances leaf development and increase green onion yield (Kka, 2021). Similarly, it has been reported that ascorbic acid (AsA) functions as a co-factor and signaling of the plant regulators biosynthesis (Barth, 2006). AsA is a non-enzymatic and is known as vitamin C service as antioxidant, detoxification of reactive oxygen species (ROS) and as inducer to plant growth and development (Smirnoff, 2018). Furthermore, it was found that exogenous application of AsA to dormant mother bulbs, enhanced root growth and elongation by modification in cell division and DNA synthesis in onion (del Córdoba-Pedregosa *et al.*, 2005). Similarly, increasing AsA level in plant organs was increased fresh and dry matter of onion roots (del Córdoba-Pedregosa *et al.*, 2007). Therefore, AsA may transport in plant organs and function as plant regulator at different growth stages. It has examined that feeding AsA to micro tomato plant showed transportation of AsA from the accumulated sources (leaves) to sink source (the immature green fruits) (Badejo *et al.*, 2011). Therefore, it may hypothesis how exogenous AsA transport from root to the flowering organs in plant.

In Iraq especially in Kurdistan, local white variety onion has been used abundantly, due to its flavor and shape, which can be used in different dishes like stuffed onion in dolma. The quantity of onion and seed production of local white variety was lower when compared with the imported variety following seed to seed method (El-Habar and Kika, 2010). Therefore, this study aims to enhance the quality and quantity of onion seeds of local white variety, following bulb to seed method and priming onion sets with SA and AsA.

## **MATERIALS AND METHODS**

### **Experimental site**

The experiment was carried out in an open farm belongs to Grdarash research center at the college of Agricultural Engineering Sciences, Salahaddin University, Erbil, Iraq. Grdarash research center is located at latitude 36° 06' 49'N, altitude 44° 00 '47' E and elevation 407m above sea level.

### **Plant material**

Onions sets, local white variety, were obtained from a local farmer. The onion sets were produced in the growing season (2020). The local white variety is a short-day onion, which require 10 and 12 hours to form bulbs (U.S. Agency for International Development, 2012). The sets were organized and graded into two groups according to the diameter size; large (>6.0 cm, diameter) and medium (4-6 cm, diameter) (Ashenafi *et al.*, 2017, Shaheen *et al.*, 2017).

### **Treatments**

After grading the onion sets into large and medium sizes as mentioned above, the base of the sets was immersed into the different concentrations of Ascorbic acid (AsA), Salicylic acid (SA) and control (water only) for 24 hours at 4°C. AsA (Scharlau, Barcelona, Spain) (1 and 2 mM) concentrations were chosen according to the previous studies with some modifications (de Cabo *et al.*, 1996, Mostafa *et al.*, 2019). SA (Scharlau, Barcelona, Spain) (0.5 and 1 mM) concentrations were chosen according to the recent published article by Kka (2021). The solutions were prepared using purified and filtered water. The sets were planted in the field on November 15<sup>th</sup> 2020.

### **Experimental Design**

Factorial experiment within three replicates using split-plot in Randomized complete block design (RCBD) was applied. The size of onion sets (Factor A (2 treatments)) placed in the main plot, and the AsA, SA treatments and control (Factor B (5 treatments)) in the sub-plot. The size of experimental unit was (1.62m<sup>2</sup>). Plants per experimental unit were 40. Total number of plants 1200.

### **Agricultural Practices**

Soil preparation, drip irrigation, sowing, fertilization, weeding and plant protection were implemented according to local farmer's practices.

### **Harvesting and seed extraction**

Umbels were harvested in August, when about 10% of black seeds were occurred to avoid shattering loss (Voss *et al.*, 2013). Harvesting was done by hands 5-15 cm below the umbel. The umbels were kept in shade to dry. After drying, the seeds were extracted from the umbels and cleaned by removing the additional materials of umbels. The seeds were dried and stored in bags in dry and aerated conditions.

## **Studied characteristics**

### **Flowering characteristics:**

#### **Emergence rate of flower stalk (day)**

The rate of flower stalk emergence was measured following the equation followed by (Maguire, 1962). The flowering was recorded every three days from the first day of flowering until the completion of flowering, for each experimental unit individually.

$$\text{Emergence rate of flower stalks (day)} = \frac{\text{Number of flowering plant}}{\text{first count}} + \dots + \frac{\text{Number of flowering plant}}{\text{days to final count}}$$

Note: The day that the first flower stalk was visible is counted as day first.

#### **The rate of umbel opening (day)**

The same equation above was used to calculate the rate of floral anthesis. The data were recorded from partially opened umbel to fully opened umbel with flower buds and open flowers.

#### **The number of stalks per plant**

The number of stalks per plant was counted for each plant individually, before harvest.

#### **The number of flowers per umbel**

The number of flowers per umbel was counted for three fully opened umbels manually per experimental unit.

#### **Umbel diameter (cm)**

The diameter of the inflorescence umbel was measured at the full fruit set stage using a vernier caliper.

#### **Umbel weight (gm/umbel)**

The weight of the inflorescence umbel was recorded individually after harvest and dry to determine the umbel weight (gm /umbel)

### **Post-harvest seed characteristics**

#### **Seed weight per umbels (gm/umbel)**

The seed of five umbels was extracted and cleaned separately from the residues. The seed was weighed using a sensitive balance.

#### **Seed yield per hectare (t.h<sup>-1</sup>)**

The total yield of umbels per experimental unit was extracted and cleaned from residues. The seed was weighed using a sensitive balance then the values were converted to t.h<sup>-1</sup>.

### **Data Analysis**

All the data were subjected to one-way analysis of variance (ANOVA) using SPSS version 25. Differences among treatment means were compared using the Duncan multiple range test (DMRT) at the 0.05 significance level. And t-test was used to compare between the set sizes. The correlation coefficient was computed to determine the relationships between and within the onion set sizes, AsA, SA and studied parameters

## **RESULTS AND DISCUSSION**

Local white onion sets treated with AsA and SA for 24 h before planting was affected significantly on growth and seed production. The results show various changes in flowering and seed yield parameters (Figure 1-2). The emergence rate of

flower stalk (bolting) and the rate of umbel opening were accelerated by using (2mM AsA and 1mM SA). The highest rate of bolting and opening umbel per day were obtained when the larger sets were pre-treated with 2mM AsA (Figure 1A, B). In addition, there was a slight increase in the rate of bolting and umbel opening when the medium size sets were pre-treated with 1mM AsA, however, the difference was not significant when compared with the control (Figure 1A, B). These results may agree with the previous data that showed that AsA link flowering time and may accelerate flowering in the plant by its function as a co-factor for the biosynthesis of some of the related flowering phytohormones (Barth, 2006). SA pre-treatments had no effect on the rate of flowering and umbel opening of local onion (Figure 1 A, B). This result disagrees with reported data found that SA functions as flower inducer and growth and development stimulator in plant (Martínez *et al.*, 2004 and Shah *et al.*, 2021). The main effect of AsA and SA treatments show no significant difference between the treated plant and control in the emergence rate of flower stalk and the rate of umbel opening (Table 1). However, onion set size more than 6 cm statistically and significantly accelerated emergence rate of flower stalk and umbel opening when compared with the medium size sets (4-6 cm) (Table 1). In agreement with Streck (2003), set size may influence the vegetative size during vernalization, and the plant with the larger set size may pass the juvenil phase before the exposure to low temperature. Therefore, the large set size of the onion in this study hastened flowering rate and umbel opening.

The highest number of flower stalks per plant was almost three when the large onion sets were pre-treated with SA (Figure 1C). The pre-sowing treatments of medium onion sets with AsA and SA were increased the number of stalks per plant slightly when compared with the control, but the differences were not statistically different (Figure 1C). The same effect of AsA and SA was found on the number of flowers per umbel when was compared with the control (Figure 1D). This phenomenon may be explained by the long-term effect and the compound may transport from plant organs and signaled the metabolism during cell division in the apical meristems. It has been shown previously that AsA level was different in plant organs and the highest accumulation level was found in the flowering buds of *Arabidopsis thaliana* (Kka *et al.*, 2017). In addition, AsA and SA may affect the cell division in the apical shoot meristem and induced the production of the lateral flower buds than untreated plants in onion. The main effect of SA pre-treatment shows that the number of stalks per plant was increased significantly when compared with control (Table 1). Furthermore, the large size onion sets were increased the number of flower stalks per plant and the number of flowers per umbel significantly (Table 1). This is in agreement with the published study, which demonstrated that the small size onion bulbs produce a smaller number of flowers per umbel (Rathore *et al.*, 1975). The large-sized sets of onion may have accumulated a higher level of nutrition and speed the cell metabolism and division in the flowering buds and with the effect of the exogenous pre-sowing treatments with AsA and SA, the number of flower stalks and flowers per umbel increased and sharply in the large size sets.

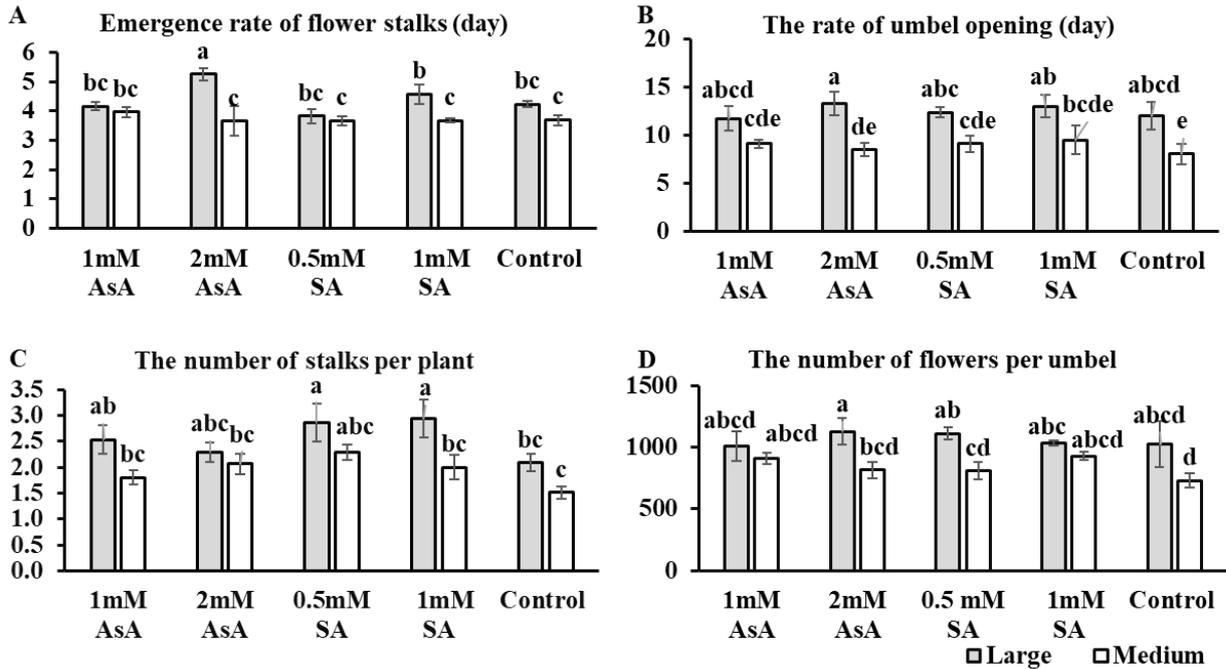


Figure (1): Interaction effect of set sizes and priming with AsA and SA on bolting and flower initiation. (A) Emergence rate of flower stalk per day. (B) The rate of umbel opening per plant. (C) The number of stalks per plant. (D) The number of flowers per umbel. Error bar represent standard error ( $\pm$ SE), n=3. The different letters are statistically different according to Duncan test,  $p \leq 0.05$ .

Table (1): The main effect of AsA and SA and onion set size on bolting and flower initiation.

	ERFS	RUO	NSP	NFU
Main effect of AsA & SA				
1mM AsA	4.060 $\pm$ 0.11 a	10.404 $\pm$ 0.85 a	2.167 $\pm$ 0.21 ab	961.33 $\pm$ 62.55 a
2mM AsA	4.455 $\pm$ 0.43 a	10.877 $\pm$ 1.24 a	2.178 $\pm$ 0.13 ab	974.056 $\pm$ 89.32 a
0.5 mM SA	3.755 $\pm$ 0.13 a	10.724 $\pm$ 0.84 a	2.578 $\pm$ 0.22 a	961.333 $\pm$ 77.64 a
1mM SA	4.124 $\pm$ 0.25 a	11.244 $\pm$ 1.16 a	2.467 $\pm$ 0.28 a	982.667 $\pm$ 28.65 a
Control	3.961 $\pm$ 0.15 a	10.0294 $\pm$ 1.19 a	1.800 $\pm$ 0.16 b	878.222 $\pm$ 109.45 a
Main effect of set sizes				
Large	4.409 $\pm$ 0.15*	12.469 $\pm$ 0.47*	2.542 $\pm$ 0.14*	1062.378 $\pm$ 44.65*
Medium	3.733 $\pm$ 0.10	8.842 $\pm$ 0.39	1.933 $\pm$ 0.09	840.667 $\pm$ 28.99

ERFS (Emergence rate of flower stalk per day). RUO (The rate of umbel opening per plant). NSP (The number of stalks per plant). NFU (The number of flowers per umbel). The average value  $\pm$ SE followed by different letters in each column is statistically different according to Duncan test. The average of set sizes is compared using the independent samples t-Test. Star (\*) represent statistically different at  $p \leq 0.05$ , ns: no statistical difference.

Generally, large and medium onion sets pre-sowing treated with AsA and SA did not show a statistical difference in the umbel diameters of onion when compared with the

control (Figure 2 A) (Table 2). While the average of large onion sets shows a significant decrease in umbel diameter when compared to the medium onion sets (Table 2). The aforementioned results may be caused by the time-lapse of umbel maturation and recording the data. The large sets show acceleration in umbel opening (Figure 1B) and an increase in the number of flowers per umbel (Figure 1D), which the umbel diameter is expected to be larger when compared with the medium size sets. However, it could be explained that during anthesis the parts of flowers are delicate and recording the umbel diameter is done gently to avoid losing the flowers in the medium sizes sets. While the flowers of the large onion sets may pass the anthesis and the fruit sets. Similarly, the medium onion sets pre-treated with 0.5mM SA produced a significant higher umbel weight, which was (17.23) gm per umbel when compared with the control (13.24) gm per umbel (Figure 2B). However, the main effect of pre-treatments and set sizes did not show differences in umbel weight (Table 2).

SA and AsA at low concentrations 0.5mM and 1mM show higher seed weight per umbel (9.58 and 8.57 gm per umbel) (Figure 2C) (Table 2). However, in general, there were no significant differences in the seed weight per umbel between the pre-sowing treatments with AsA and SA of large and medium onion sets (Figure 2C). On the other side, seed yield was boosted by increasing the concentration of SA and AsA, which was (2.37 and 2.05 t.h<sup>-1</sup>), respectively (Figure 2 D). In addition, the most supporting results were that the medium size sets pre-treated with AsA and SA slightly increased seed yield when compared with control (Figure 2D) and seed weight per umbel was increased significantly by priming treatment (Table 2). In agreement with previous data, AsA may alter the metabolism of cells specifically during cell division and expansion (del Córdoba-Pedregosa *et al.*, 2005 and Kka *et al.*, 2018). Therefore, during seed development, the process of seed formation may be modified by the additional AsA accumulated in the reproductive organs. In a similar way, SA modulated the process of seed formation in onions. It has been illustrated that SA in addition to its defence property in the plant, modulates and promote the growth and development of the plant (Arif *et al.*, 2020). AsA and SA are plant molecules, which protect the plant from biotic and abiotic stress (Martínez *et al.*, 2004 and Smirnoff, 2018), additionally, they function as flowering promoters by modulating and signalling plant hormones during flowering (Arif *et al.*, 2020 and Barth, 2006). The large size of onion sets showed a positive effect on seed yield (Table 2). This phenomenon has been studied and was described by the additional nutrition available for the plant growth in the large sets in comparison to the small sets (Khokhar, 2008 and Rathore *et al.*, 1975).

Correlation Analysis among set size, AsA, SA and flowering and seed formation parameters showed positive and negative correlation, but most significant at the level 0.01 (Table 3). Onion set size and pre-sowing treatment with AsA and SA were found to be correlated negatively with the emergence rate of flower stalks per day, the rate of umbel opening per plant, the number of flower stalks per plant, the number of flowers per umbel and seed yield (t.h<sup>-1</sup>). While onion set size correlated positively and significant at 0.05 level, to umbel diameter. No correlation was found between set size, AsA, SA and umbel weight and seed weight per umbel. The emergence rate of flower stalks per day correlated positively and significantly with the rate of umbel

opening per plant, the number of flower stalks per plant, the number of flowers per umbel and seed yield ( $t.h^{-1}$ ). Table 3 shows that the correlation between umbel diameter, umbel weight and seed weight per umbel was weak in comparison with the other parameters. But seed yield was positively and significantly correlated with set sizes, AsA and SA treatments and the other studied parameters.

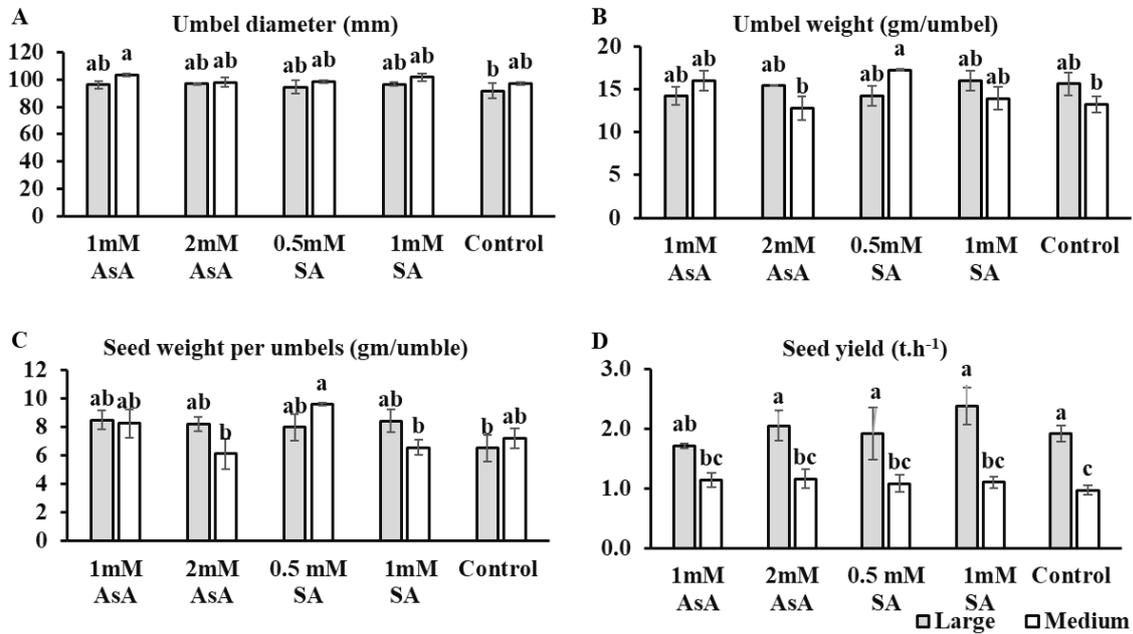


Figure (2): Interaction effect of set sizes and priming with AsA and SA on umbel and seed parameters of onion. (A) Umbel diameter (mm). (B) Umbel weight (gm per umbel). (C) Seed weight per umbel (gm). (D) Seed yield ( $t.h^{-1}$ ). Error bar represent  $\pm SE$ ,  $n=3$ . Different letters are statistically different according to Duncan test,  $p \leq 0.05$ .

Table (2): The main effect of AsA and SA and onion set size on umbel and seed yield of onion.

	UD (mm)	UW (gm)	SWU (gm)	SY (t.h <sup>-1</sup> )
<b>Main effect of AsA &amp; SA</b>				
1mM AsA	99.683±2.12 a	15.095±0.81 a	8.361±0.54 ab	1.427±0.14 a
2mM AsA	97.333±1.61 a	14.122±0.84 a	7.151±0.70 ab	1.607±0.24 a
0.5 mM SA	96.533±2.35 a	15.733±0.84 a	8.772±0.55 a	1.501±0.28 a
1mM SA	99.100±1.83 a	14.967±0.92 a	7.478±0.61 ab	1.737±0.32 a
Control	94.450±2.80 a	14.433±0.88 a	6.856±0.54 b	1.445±0.22 a
<b>Main effect of set sizes</b>				
Large	95.140±1.45	15.093±0.44 <sup>ns</sup>	7.911±0.35 <sup>ns</sup>	1.994±0.12*
Medium	99.700±1.03*	14.647±0.61	7.536±0.44	1.093±0.05

UD (Umbel diameter), UW (Umbel weight) SWU (Seed weight per umbel. SY (Seed yield). The average value ±SE followed by different letters in each column is statistically different according to Duncan test. The average of set sizes is compared using the independent samples t-Test. Star (\*) represent statistically different at  $p \leq 0.05$ , ns: no statistical difference.

Table (3): Correlation Analysis of onion set sizes, pre-sowing treatments flowering and seed yield parameters.

<b>Correlations (Pearson Correlation)</b>										
	Set sizes	AsA & SA	ERF	RUO	NFS	NFU	UD	UW	SWU	SY
<b>Set sizes</b>	1	.870**	-.572**	-.745**	-.564**	-.618**	.436*	-0.111	-0.124	-.797**
<b>AsA &amp; SA</b>		1	-.560**	-.660**	-.548**	-.600**	0.264	-0.113	-0.232	-.674**
<b>ERF</b>			1	.654**	.400*	.462*	-0.052	0.111	0.219	.679**
<b>RUO</b>				1	.539**	.746**	-0.359	0.099	0.093	.743**
<b>NFS</b>					1	.405*	-0.209	-0.028	0.105	.664**
<b>NFU</b>						1	-0.300	0.076	0.057	.645**
<b>UD</b>							1	.393*	.403*	-0.268
<b>UW</b>								1	.751**	0.055
<b>SWU</b>									1	0.117
<b>SY</b>										1

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

Values without any asterisk are non-significant ( $P > 0.05$ )

The prefixes in the table indicated to emergence rate of flower stalk per day (ERF), the rate of umbel opening per plant (RUO), the number of flower stalks per plant (NFS), the number of flowers per umbel (NFU), umbel diameter (mm) (UD), umbel weight (gm per umbel) (UW), seed weight per umbel (gm per umbel) (SWU) and seed yield (t.h<sup>-1</sup>) (SY)

## CONCLUSIONS

seed production is an important practice locally and internationally. Seeds purity, quality and quantity are the farmers' concerns around the world. Onion seeds have been paid more attention among other vegetable crops, due to their low longevity, which lasts within a year. Therefore, the demand for good quality onion seeds is high, especially the local variety. In Iraq, onion local white cultivar is consumed heavily freshly, green leaves and dried bulbs. Therefore, the need to improve seed is the farmer's request. The result of this study indicated that large size onion sets of more than 6 mm have improved the flowering and seed quantity of local white onion. In addition, pre-sowing treatment with AsA and SA was modulated growth and seed yield of onion not just for the large onion sets, but also for the medium set size 4-6mm. A strong correlation was recorded between the onion set sizes and the treatments and flowering and seed parameters and most was positive and significant. It could be suggested that specific exogenous application before sowing with AsA and SA has a significant effect on flowering and seed yield of onion local white cultivars. Therefore, it may recommend using a AsA and SA before sowing for short time to accelerate and improve the quantity of the yield. However, further studies are demanded to examine different natural products which may have the same effect and compared with AsA and SA.

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## CONFLICT TO INTEREST

The authors declare that no conflict of interest exists.

تقييم كفاءة فسقات البصل (*Allium cepa* L.) المعاملة بحامض الاسكوربيك وحامض السالسليك في

تحفيز النمو ونتاج البذور

منيرة مهدي صالح نوره ككه

قسم البستنة، كلية علوم الهندسة الزراعية ، جامعة صلاح الدين-اربيل، اقليم كردستان، العراق

## الخلاصة

البصل (*Allium cepa* L.) هو احدى المحاصيل الاقتصادية والمستهلكة بكثرة حول العالم. الحاجة الى بذور البصل ملحة بسبب فقدان فعالية البذور خلال سنة. في العراق، انتاج بذور البصل محدود بسبب نقص في البذور ذات النوعية الجيدة وبالاخص الاصناف المحلية. ولهذا هذه الدراسة اجريت لتحسين النوعية ونتاجية البذور للبصل صنف الأبيض المحلي بإستخدام احجام فسقات الملائمة والمعاملة قبل الزراعة بهرمونات النمو. دراسة حقلية اجريت في حقل كردرش التابع لجامعة صلاح الدين، اربيل. تم تطبيق القطاعات المنشقة بتصميم القطاعات العشوائية الكاملة وبثلاث مكررات. فسقات البصل الحجم الكبير(القطر

اكبر من 6 سم) والمتوسط (القطر ما بين 4-6 سم) تم اختيارها. القواعد القرصية لفسقات البصل تم غمرها في حاض الاسكوربيك بتركيز 1 و 2 ملي مولار وحامض الساليسليك بتركيز 0.5 و 1 ملي مولار بالإضافة الى معاملة المقارنة (فقط المعاملة بالماء) لمدة 24 ساعة وبدرجة حرارة 4 درجة مئوية. بينت النتائج بأن سرعة ظهور الشماريخ الزهرية و سرعة انشقاق (فتح) النوره الخيمية و عدد الشماريخ الزهرية للنبات الواحد و عدد الأزهار للنورة الخيمية و انتاج البذور (طن للهكتار الواحد) ازداد احصائياً ومعنوياً باستخدام فسقات البصل كبيرة الحجم. المعاملة بحامض الاسكوربيك والساليسليك اظهر تأثيره الايجابي على الخصائص الزهرية والإنتاجية (البذور). علاقة ايجابية وجدت بين المعاملات اعلاه و انتاج بذور البصل. ولكن الحاجة الى دراسات اخرى ملحة لتقييم كفاءة المستخلصات الطبيعية والتي لها خصائص حامض الاسكوربيك والساليسليك على النمو والتطور لمحاصيل الخضر.

**الكلمات الدالة:** فسقات البصل، حامض الاسكوربيك، حامض الساليسليك، انتاج البذور.

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