

GERMINATION ENCOURAGEMENT OF SOME POTATO SEED CULTIVARS

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ABSTRACT

The present research was carried out at experimental station of faculty of agriculture, Mansoura University Dakahlia Governorate, Egypt, during successive season of 2011 to study the effect of some plant growth regulators treatments *i.e.* control, IAA at concentration of 6 ppm, GA3 at concentration of 10 ppm, IAA at 3 ppm + GA3 at 5 ppm and IAA at 6 ppm + GA3 at 10 ppm, and its soaking time *i.e.* at (10 minutes, 20 minutes and 30 minutes on some germination and vegetative parameters of some potato (*Solanum tuberosum* L.) cultivars *i.e.* Cara, Draga and Spunta. The main results could be summarized as follows:

Concerning cultivars performance, results showed that Cara cultivar recorded highest germination index followed by Spunta cultivar without significant differences between them. Draga cultivar recorded tallest plant, highest fresh weight and dry weight in gm/plant followed by Cara cultivar for plant height only and followed by spunta for fresh and dry weight without significant differences between them.

Regarding to plant growth regulators effects, the results indicated that there are a significant differences between growth regulators treatments on germination index, mean germination time, plant height, fresh and dry weight of tubers. Highest values of germination index percentage, plant height and fresh and dry weight of tubers were obtained from soaking tubers in GA3 at 10 ppm plus IAA at 6 ppm. While, soaking tubers in GA3 at concentration of 10 ppm produced highest value of mean germination time.

Regarding to the effect of soaking time of growth regulators, results clearly indicated that there is a significant differences between times of soaking on fresh weight per plant. Soaking tubers for 30 minutes produced highest values of fresh weight followed by soaking for 20 minutes without significant differences between them. The interaction among cultivars and growth regulator treatments recorded significant differences on mean germination time, fresh weight and dry weight.

The objectives of this work were aimed to evaluate the effect some growth regulators, soaking times and their interactions on encouragement germination capacity of some potato tuber cultivars.

Keywords: Potato cultivars, growth regulators, germination index and vegetative parameters.

INTRODUCTION

Potato, (*Solanum tuberosum* L.) is a major food crop in many countries of the world. In Egypt, potato considered to be one of the most important vegetable crops for local consumption, and exportation. Bud dormancy is a characteristic prevalent in many plant species. It can be initiated by various factors, including moisture stress, high or low temperatures, day length and heredity (Hartmann *et al.* 2002). Fresh potato tubers are in a state of endogenous dormancy which must be terminated before sprout growth will commence. When gibberellins are applied to dormant tubers, dormancy can

be broken according to Hemberg (1985), Coleman (1987), Burton (1989) and Ferine and Willmitzer (2001). Kurzinger (2007) showed that potato tubers remain dormant for up to 10 weeks depending on the variety and seasonal weather conditions during the growth period.

Gibberellins (GA) stimulate cell division and elongation, break seed dormancy and speed germination at low concentration. Whereas, indol-3-acetic acid (IAA) plays an important role in an extent range of growth and development processes. Allen *et al.* (1992) used in success GA to stimulate sprouts growth of potato seeds. Sharma *et al.* (1999) found that GA3 enhanced both shoots and stolons growth and dry weight of plant but decreased starch content of tuber. Similar conclusions were reported by Meliha *et al.* (2000), Puzina *et al.* (2000) and Suttle (2004). Struik *et al.* (1999) it was discovered that gibberellins play a very important role in the regulation of growth and development in higher plants. El-Banna *et al.* (2006) They found that soaking application of seed tubers in mixture of GA3+IAA at concentration of 5+3 ppm for 10 minutes before planting was very effective on the plant start at 21 and 28 day after planting, increase vegetative growth parameters, improved tubers quality, tubers yield and its components as compared to the control and other treatment. Similar results were agreement with those reported by El-Helaly (2009).

The successful soaking process in the growth regulators was depend on the time was taken, So the researcher must be take this steps by all of careful to ensure to get the accurate results. Hak *et al.* (2004) studied found that plants grown in commercial soil and sprayed with GA3 100 ppm had shortened the dormancy period by 30-80% in 'Atlantic' and 28-53% in 'NorValley' under room temperature and 5-12.5% in 'Atlantic' and 0-7.5% in 'NorValley' under 4°C condition compared to the untreated control. Otrshy and Struik (2008). found that GA3 on the length of the longest sprout was indeed different among cultivars. Frieslander did not react on GA3 in contrast to cultivar Marfona, which showed a strong response to both doses of GA3 by producing longer sprouts Similar conculsions were reported by Faten Abd El-Aal *et al.* (2008).

Regarding to the interaction between cultivars and time of soaking, EL-Banna *et al.* (2006) found that increased in vegetative growth and tuber yield by treatment GA3 at 5 ppm + IAA at 3 ppm. Otrshy and Struik (2008) soaked GA3 for 10 minutes resulted highest number of sprouts and uncut control produced lowest number of sprouts. Frieslander cultivar produced higher number of sprouts and also more weight of sprouts than other cultivars, This similar results were agreement with the reported by Marwa Shalaby(2009). Regarding to the interaction between growth regulators and time of soaking, El-Sayed (1991) indicated that GA at 50 ppm caused an obvious increase in stem length. El-Helaly (2009) reported that tubers were dipped in 5 or 7 mg/liter for 5 minutes before sowing and compared with tuber dipped in water. GA3 7 mg/liter resulted in a significant increase in average plant height in the first season.

MATERIALS AND METHODS

The present research was carried out at experimental station of faculty of agriculture, Mansoura University during season 2011 to study the effect growth regulators treatments and its time soaking on germination capacity of some potato cultivars.

Three cultivars of the commercial cultivated potatoes *i.e.* Cara, Draga, Spunta were used and get it from ministry of agriculture, potato producer society. Plastic bags with four pores filled with 3kg sand loamy soil each were separately planted with one peace tuber of one sprout from each tested cultivars. One hundred and thirty five plastic bags were used in this experiment, forty five for each potato cultivar. Plastic bags then received water as needed. All plastic bags were arranged in split plot design system with for replicates. Germination and vegetative parameters were measured.

Five treatments of plant growth regulators *i.e.* control, IAA at concentration of 6 ppm, GA3 at concentration of 10 ppm, IAA at 3 ppm + GA3 at 5 ppm and IAA at 6 ppm + GA3 at 10 ppm.

Effect of two growth regulators *i.e.* IAA and GA3 singly or mixed or in combination at half doses to study this affect of such growth regulators *i.e.* IAA or GA3 or their mixture or half of their mixture at three times of soaking. Each treatment was replicated three times. Three time of soaking were applied *i.e.* (10, 20 and 30 minutes).

In this experiment, forty five black plastic bags with four small pores (two at each side) containing 3 kg, sandy loam soil were planted with one piece tuber with one sprout of potato seed cultivars /bag after soaking in such growth regulators under study, *i.e.* IAA at 6ppm or GA3 at 10 ppm or their combination at the half dose for 10, 20 and 30 minutes before planting on February 2011. Treatments were as follows, where each was replicated three times. All plastic bags then received water as needed and other agricultural practices as NPK etc. were carried out according to the recommendations of the Ministry of Egyptian Agriculture. All plastic bags were arranged in split plot design system. Seventy five days after seed germination, vegetative growth parameters were determined and recorded as this was the peak of its growth.

Studied characters:

A- Germination Parameters:

1-Germination index (GI): It was calculated as described by International Seed Testing Association 1996 as the following formulae:

$$GI = \frac{\text{No. of germinated seeds} \div \text{Days of first count} + \dots + \text{No. of germinated seeds} / \text{Days of final count}}$$

2-Coefficient of velocity (CV): a unit less parameter determined by a mathematical manipulation that incorporates the number of seeds germinated and the velocity of germination was calculated using the following formula:

$$CV = 100 \left[\frac{\sum Ni}{\sum Ni Ti} \right]$$

Where N is the number of seeds germinated on day I and T is the number of days from sowing (Scott, Jones and Williams, 1984). In general, a higher CV value reflects increased germination and shorter germination time.

3-Mean germination time (MGT): It was determined according to the equation of Ellis and Roberts (1981):

$$\text{MGT} = \frac{\sum dn}{\sum n}$$

Where (n) is the number of seeds which were germinated on day (d), and (d) is the number of days counted from the beginning of germination

B-Vegetative growth parameters:

- 1- Plant height: Plant height representative in main stem was measured as the average height in centimeters of plants. The measurement started from the surface of ground to plant stem apex.
- 2- Plant fresh weight: Fresh weight of plant representative in main stem was determined as the average weight per plant in grams from each replication.
- 3- Plant dry weight: Fresh plants were dried out in an oven till constant weight at 70 °C.

Statistical analysis:

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split – plot design as published by Gomez and Gomez (1984) by using means of “MSTAT-C” computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1-Performance of cultivars:

The results in Table 1 showed that Cara cultivar recorded highest value of germination index (13.52%) followed by Spunta cultivar (12.02%) without significant effect between them. Similar conclusions were recorded by Stuik and Wiersem (1999); Mikitel (2004); Shuttle (2004); Otrshy and Struik (2008) and Hoque (2010). The results showed that Draga cultivar recorded highest value of plant height, fresh weight and dry weight (22.93 cm), (91.24 g/plant) and (20.55 g/plant), respectively followed by Cara cultivar for plant height only (22.84 cm) and followed by Spunta cultivar for fresh weight and dry weight (79.77 g/plant) and (19.77 g/plant) without significant differences between them. These results are in agreement with those obtained by El-Sayed (1991); Sharma *et al.* (1999); Meliha *et al.* (2000); Mikitel (2004); Hak *et al.* (2004); Kustiati *et al.* (2005); Zhijun *et al.* (2005) and EL-Banna *et al.* (2006).

2- Growth regulators effects:

The results in Table 1 indicated that a significant difference between growth regulators treatments on germination index, highest germination index was obtained by soaking in GA₃ at concentration of 10 ppm plus IAA at concentration of 6 ppm (16.76%) followed by soaking in GA₃ at concentration of 10 ppm (16.66%). Similar conclusions were recorded by Stuik and Wiersem (1999); Otrshy and Struik (2008); Hoque (2010) and Kurzinger (2007). Meanwhile significant differences between growth regulator treatments for mean germination time, soaking in GA₃ at concentration of 10

ppm produced highest value of mean germination time (16.54 days) followed by soaking in GA3 at concentration of 10 ppm plus IAA at concentration of 6 ppm (16.85 days). Similar conclusions were reported by Bamberg (2000) and El-Banna *et al.* (2006). The results in Table 1 indicated that a significant differences between growth regulators for all vegetative parameters, tallest plants, highest fresh weight and dry weight were obtained from soaking in GA3 at 10 ppm plus IAA at 6 ppm followed by GA3 at concentration of 10 ppm (23.55 and 23.40 cm for plant height), (111.85 and 83.70 g/plant for fresh weight) and (22.77 and 20.37 g/plant for dry weight). These results are in agreement with those obtained by El-Sayed (1991); Sharma *et al.* (1999); Meliha *et al.* (2000); Mikitzel (2004); Hak *et al.* (2004); Kustiati *et al.* (2005); Zhijun *et al.* (2005) and EL-Banna *et al.* (2006).

Table 1: Averages of germination index, coefficient velocity, mean germination time, plant height (cm), fresh weight (g/plant) and dry weight (g/plant) as affected by cultivars, growth regulators treatments and time of growth regulators soaking and their interactions.

Treatments	Germination index	Coefficient velocity	Mean germination time	Plant height (cm)	Fresh weight (g/plant)	Dry weight (g/plant)
A: Potato cultivars:						
Cara	13.52	0.056	18.01	21.84	55.44	17.77
Draga	9.82	0.054	18.12	22.93	91.22	20.55
Spunta	12.02	0.071	17.68	20.75	79.77	19.66
F-test	*	N.S	N.S	**	**	**
LSD 5 %	2.83	-	-	1.03	4.28	1.29
LSD 1 %	-	-	-	1.37	5.68	1.72
B: Growth regulators treatments						
GA3 10 ppm	16.66	0.084	16.54	23.40	83.70	20.37
IAA 6 ppm	9.83	0.054	18.18	22.14	59.25	17.77
GA3 10 ppm+IAA 6 ppm	16.76	0.062	16.85	23.55	111.85	22.77
GA3 5 ppm+IAA 3 ppm	11.28	0.057	17.41	21.37	76.66	20.00
Control	4.42	0.046	20.68	18.74	45.92	15.74
F- test	**	N.S	**	**	**	**
LSD 5%	3.65	-	1.17	1.34	1.48	1.67
LSD 1%	4.85	-	1.55	1.74	1.36	2.22
C: Time of growth regulators soaking						
10 minutes	12.08	0.070	17.84	21.35	72.11	19.66
20 minutes	11.53	0.057	17.62	22.04	75.00	18.77
30 minutes	11.76	0.054	18.34	22.13	79.33	19.55
F-test	N.S	N.S	N.S	N.S	**	N.S
LSD 5%	-	-	-	-	4.54	-
LSD 1%	-	-	-	-	6.03	-
D: F-test Interaction						
AXB	N.S	N.S	*	N.S	**	**
AXC	*	N.S	N.S	N.S	N.S	*
BXC	N.S	N.S	N.S	**	N.S	N.S
AXBXC	N.S	N.S	N.S	**	N.S	**

3- Time of soaking effects:

Regarding to the effect of time of growth regulators soaking, the results in Table 1 clearly indicated that there is significant differences between times of soaking on fresh weight per plant. Growth regulators soaking for 30 minutes produced highest fresh weight (79.33 g/plant) followed by soaking for 20 minutes (75.00 g/plant) without significant differences between them. Similar trends were reported by Sharma *et al.* (1999); Meliha *et al.* (2000); Mikitzel (2004); Kustiati *et al.* (2005); Zhijun *et al.* (2005) and EL-Banna *et al.* (2006).

4- Interaction effects:

The results indicated that interaction among cultivars and growth regulator treatments recorded significant differences on mean germination time, fresh weight and dry weight. The best value of mean germination time obtained by soaking of Spunta cultivar in GA3 at 10 ppm plus IAA at 6 ppm followed by soaking Cara cultivar in GA3 at concentration of 10 ppm without significant differences between them (Fig. 2). Highest plant fresh weight per plant was obtained from soaking Draga cultivar in GA3 at 10 ppm plus IAA at 6 ppm followed by Spunta cultivar when soaked in the same treatment (Fig. 4). Highest plant dry weight was produced from soaking Draga cultivar in GA3 at 10 ppm plus IAA at 6 ppm followed by Spunta cultivar when soaking in the same treatment (Fig. 5). The results indicated that significant differences due to the interaction between cultivars and times of soaking in growth regulators on germination index (Fig. 1). The highest germination index obtained by soaking Cara cultivar for 30 and 20 minutes, respectively followed by soaking Spunta cultivar for 10 minutes without significant differences between them. Highest dry weight was obtained by soaking Draga cultivar for 20 and 30 minutes, respectively followed by soaking Spunta cultivar for 30 minutes without significant differences between them (Fig. 6). There is a significant difference in the interaction between growth regulators and times of soaking on plant height as illustrated in (Fig. 3). The tallest plants was obtained by soaking cultivars in GA3 at concentration of 10 ppm for 20 minutes followed by soaking cultivars in GA3 at concentration of 10 ppm plus IAA at concentration of 6 ppm for 20 and 10 minutes without significant differences between them.

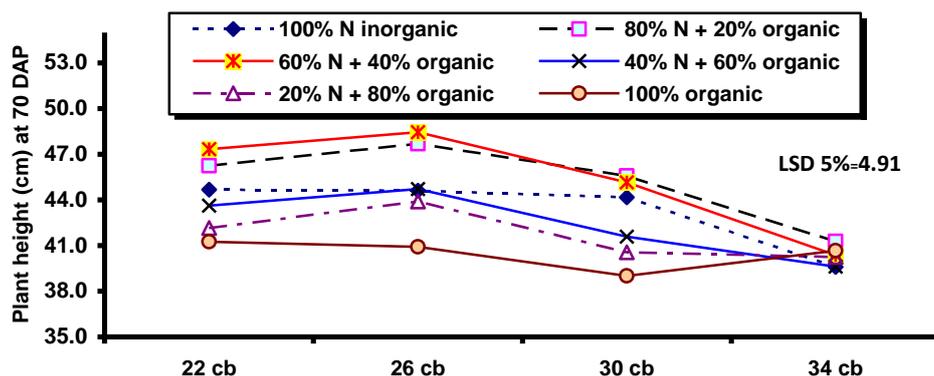


Fig. 1: Averages of germination index as affected the interaction between cultivars and times of growth regulators soaking.

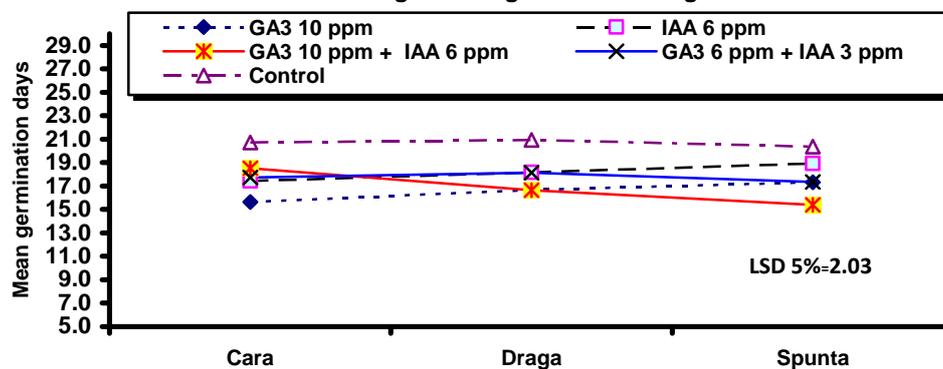


Fig. 2: Averages of mean germination time as affected the interaction between cultivars and growth regulators treatments.

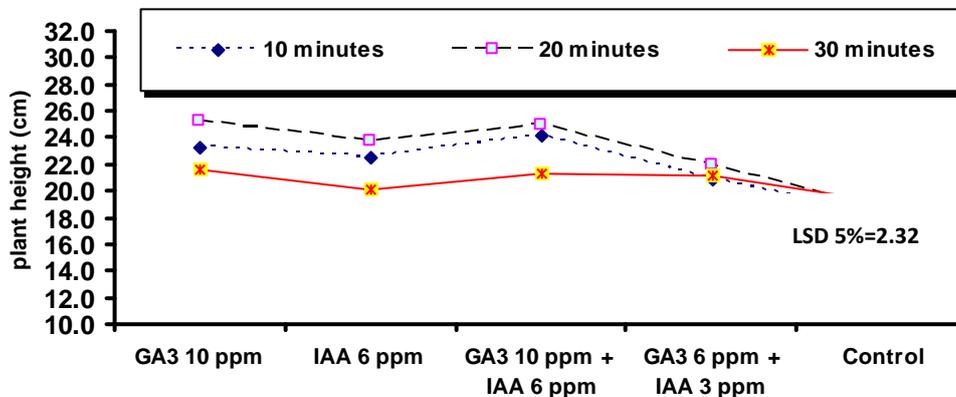


Fig. 3: Averages of plant height (cm) as affected the interaction between growth regulators treatments and time of growth regulators soaking.

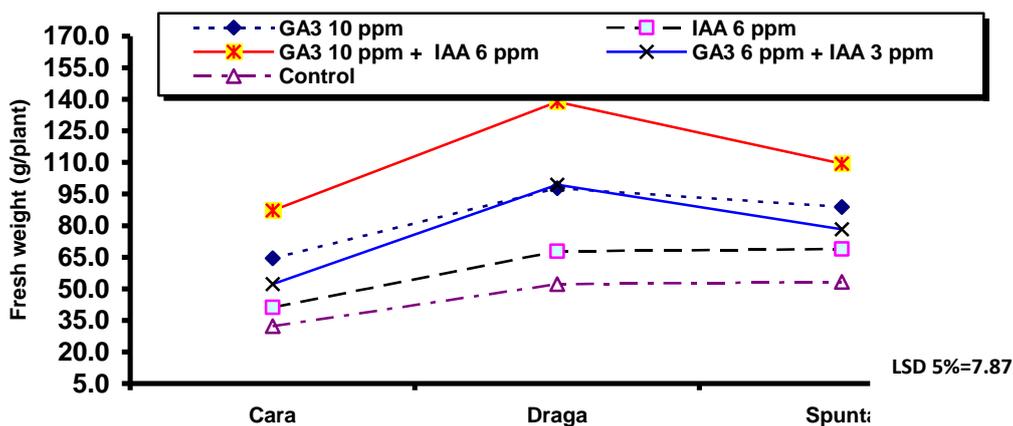


Fig. 4: Averages of fresh weight (g/plant) as affected the interaction between cultivars and growth regulators treatments.

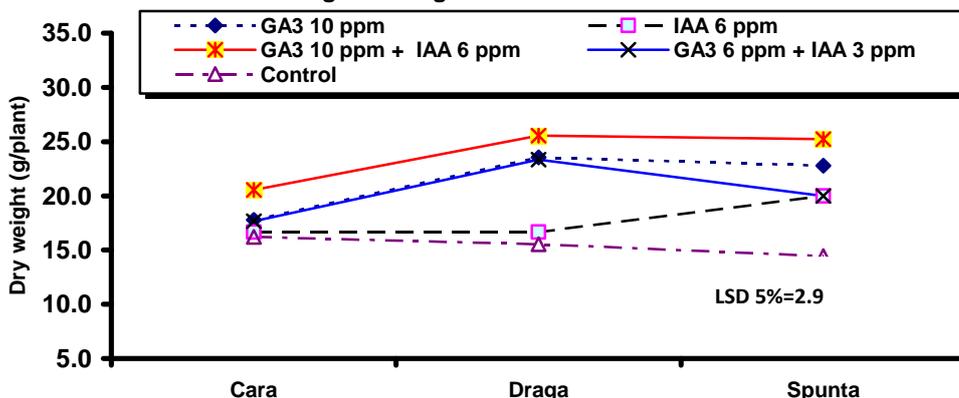


Fig. 5: Averages of dry weight (g/plant) as affected the interaction between cultivars and growth regulators treatments.

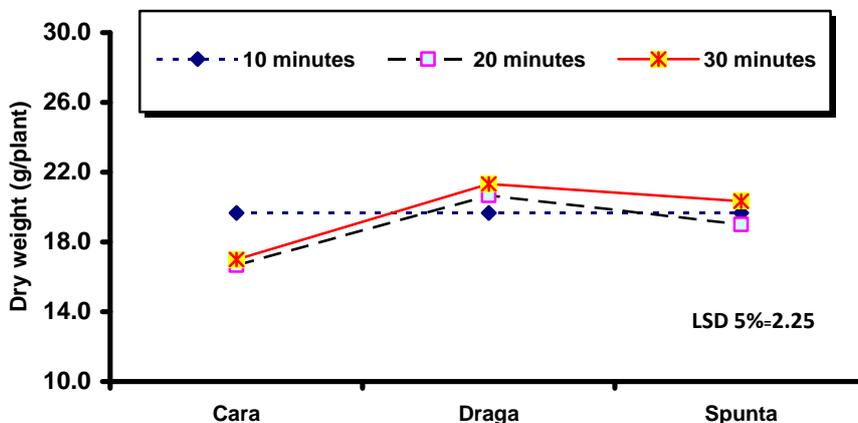


Fig. 6: Averages of dry weight (g/plant) as affected the interaction between cultivars and time of growth regulators soaking.

CONCLUSIONS

In general, for encouragements germination and growth of potato seed tubers it could be achieved by sowing Cara cultivar, soaking tubers in GA₃ at concentration of 10 ppm plus IAA at concentration of 6 ppm for 30 minutes.

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تشجيع إنبات بعض أصناف تقاوى البطاطس

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أجريت تجربة بالصوبة بكلية الزراعة جامعة المنصورة خلال الموسم الصيفي ٢٠١١ وذلك لدراسة تأثير نقع درنات بعض اصناف البطاطس المستوردة في منظمات النمو مثل حمض الجبرلين بتركيز (١٠ و ٦ جزء في المليون)/لتر وأندول حامض الخليك بتركيز (٦ و ٣ جزء في المليون)/لتر وذلك خلال أوقات نقع وهى (١٠ و ٢٠ و ٣٠ دقيقة) وذلك على قياسات الانبات وقياسات النمو الخضري.

١- أظهرت النتائج أن الصنف كارا قد سجل أعلى قيم لمعامل سرعة الإنبات (%) يليه صنف سبونتتا ثم صنف دراجا. سجل الصنف دراجا أعلى القيم لكل من طول النبات والوزن الغض والجاف يليه صنف كارا لصفة طول النبات وصنف سبونتتا لصفة الوزن الغض والجاف.

٢- أشارت النتائج أن نقع تقاوى البطاطس بخليط (GA3+IAA) بتركيز ٣٠ دقيقة وبتركيز ١٠ و ٦ جزء في المليون على التوالي كان فعالا جدا على قياسات الانبات والقياسات الخضرية وذلك مقارنة بالكنترول.

٣- أشارت النتائج أن التفاعل بين الأصناف والنقع في منظمات النمو كان له تأثيرا معنويا على صفة متوسط مدة الانبات(عدد الايام) وصفة الوزن الغض والوزن الجاف (جرام/نبات) بينما كان للتفاعل بين الاصناف ومدة النقع تأثير معنوى على صفة معامل سرعة الانبات (%) وصفة الوزن الجاف (جرام/نبات)، وكان التفاعل بين منظمات النمو ومدة النقع تأثير معنوى على صفة طول النبات، وكان التفاعل بين الاصناف ومنظمات النمو ومدة النقع تأثير معنوى على صفة طول النبات والوزن الجاف.

توصى الدراسة لتشجيع إنبات تقاوى درنات البطاطس بزراعة الصنف كارا ونقع الدرنات بمادة الجبرلين بتركيز ١٠ جزء في المليون مخلوطة بمادة أندول حامض الخليك بتركيز ٦ جزء في المليون وذلك لمدة ٣٠ دقيقة.

قام بتحكيم البحث

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