Effect of cultivar, Pro.Sol, Folicist and their interactions on some vegetative growth of olive transplants (*Olea europea* L.) cvs. Sorany and Picual (b)

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Abstract

This study was carried out during the growing season (2014) in Bakrajo Nursery Station/ Sulaimani, Kurdistan Region-Iraq. Uniform and healthy olive (*Olea europaea* L.) cvs. Sorany and Picual transplants of (2) years old were used.To investigate the effect of three Folicist concentrations (0 , 60 and 120mg.L^{-1}), three Pro.Sol concentrations (0 , 100 and 200mg.L^{-1}) and their interactions on some vegetative growth of olive transplants. The results were summarized as follows: Foliar sprays of Folicist significantly dominated Pro.Sol in vegetative growth, except plant height and leaf area. Picual cv. significantly dominated cv. Sorany in all vegetative growth, except leaf number per shoot. The interactions between Pro.Sol, Folicist and cv. Picual affected significantly leaf area, Whereas, Pro.Sol, Folicist and cv. Sorany increased plant height and leaf number per shoot significantly.

Key word: Pro.Sol, Folicist, Olive cultivar, Vegetative growth.

Introduction

Olive (*Olea europea* L.) goes back to the olive family (Oleaceae) which does not include with olive any other species. Product of fruits has a nutritional economic value, and it's the only type that belongs to this family, and gives edible fruits with great importance. This family contains about (30) genus and (35-40) species (Khadam and Flip, 1998).

In Iraq, olive trees growing in some areas of central and Kurdistan of Iraq, Nineveh is the governorate leading olive producer, its cultivation in Nineveh spreading in an area including villages of (Baashiqa , Bahzany , Fadiliya , Sheikh Uday , Dhecan , Sinjar), Diyala, Kirkuk, Baghdad, Erbil, Duhok, Aqrah, Bamerni, followed by Babylon (Mahdi, 2007 and Abdul-Qader, 2012).

Olive mentioned frequently in the Holy Quran 6 times, this replication is a sign of great importance of olive which came from therapeutic and the food benefits (Shaker, 1989).

Olive is considered as evergreen fruit trees, oldest for hundreds of years. Its fruits are rich in important materials as oils, carbohydrate, protein, vitamins and mineral elements like phosphorus, calcium, iron and other (Ibrahim, 1998).

The importance of olive fruit is due to heavy loading and dietetic value, as the fruit is a good source of vitamins (A, B, C, D, E, and K) and mineral like (K , Ca ,

Mg and P) (Ibrahim and Khalaef, 2007). In addition, olive oil is filled with mono-unsaturated fatty acids and has many anti-oxidative properties as phenolic acid (Hill and Giacosa, 1992;Trichopoulou, 1995 and Stark and Madar, 2002).

Leaf nutrient analysis is the best method for diagnosing tree nutritional status

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and represents an important tool for determining future fertilization requirements. Presently, the use of leaf analysis as a guide for olive fertilization is still infrequent in Mediterranean countries (Benton, 1985 and Fayed, 2010).

This investigation aimed to:

1- Study the olive transplants cvs. (Sorany and Picual) to improve and increase their vegetative growth affected via (Pro.Sol and Folicist) fertilizers.
2- Determine the best timing of (Pro.Sol and Folicist) spray in the climate of Kurdistan region.
3- Comparison between the effect of spraying (Pro.Sol and Folicist) on olive transplants.
4- Impact of two olive cultivars which newly entered to the region on the vegetative and root growth of olive transplant.

Materials and Methods:

The study was carried out during the season (2014) in the Nursery of Bakrejo Station / Sulaimania. Kurdistan region-Iraq, about 15km from Sulaimania city center, the elevation of the orchard is 760m above sea level and situated at the latitudes 35 ^{o}, 55^{-}, 09$^{=}$ N and longitudes 45 ^{o}, 35^{-}, 18$^{=}$ E. Uniform and healthy olive (cvs. Sorany and Picual) transplant of (2) years old were used in this study. The experiments were started in (May 23th 2014), as transplants were grown in pots each of (5kg) weight, filled with river soil (Restrepo-Diaz et al, 2008). Three Folicist concentrations (0, 60 and 120mg.L^{-1}), It contains organic nitrogen(18.1 g/L), organic carbon of biological origin (133.1 g/L), potassium oxide (73.8 g/l) and betaines (121 g/L), three Pro.Sol concentrations (0,100 and 200mg.L^{-1}), It contains nitrogen (%20), P_2O_5 (%20), potassium oxide dissolution in water (K_2O) (%20) and several macro and micro elements such as; boron, iron, manganese, moulibdenm, zinc and copper, and their interactions were sprayed at 25th May and repeated at same concentrations in 25th June (Agha and Daoud, 1991).

Subject area to experience the climatic conditions prevailing in Kurdistan, a sime-relaible rainfall, which is characterized by cold and rainy winters, hot and dry summer.

Experimental design and statistical analysis:

Experiments conducted in this study followed a Complete Randomized Block Design in afactorial experiment. The experiment comprised of (18) treatments with

three replicates, each replicate was presented by five pots, each pot contains one transplants (2*3*3) (Al-Rawi and Khalafalla, 1980).

Obtained data were tabulated and statistically analyzed by computer using **SAS system (1996)**. The differences between various treatment means were tested with Duncun multiple range test at (5%) level. (SAS, 1996).

The following measurements were recorded on **25th November** 2014.

1- Plant height (cm).

Length of the main stem of each transplant was measured using the metric ruler.

2- Leaf numbers per shoot.

3- Single leaf area (mm^2).

4- Leaf fresh weight (mg).

5- Leaf dry weight (mg).

For each randomly transplant (50) leaves were taken. These leaves were cleaned and washed several times with tap water, then washed again by HCl (0.01 N) and rinsed by distilled water to remove any spray residues. After the leaves weight was taken, they were oven-dried at (70) ^{o}C until constant weight (Gobara, 1998). Percentage dry weight was then calculated by the following equation:

$$\text{Leaves dry weight (\%)} = \frac{\textbf{Dry weight}}{\textbf{Fresh weight}} \boldsymbol{x\ 100}$$

Results and Discussion

1- Plant height (cm)

Table (1) shows that the untreated transplant with Pro.Sol gave the highest value of plant height (97.69 cm), whereas the lowest value (93.11 cm) was recorded with 100mg Pro.Sol.L^{-1} and Folicist had no effect on plant height of both cultivars.

Results of either cultivar revealed that there was no significant effect on plant height but 'Picual' gave the highest plant height (94.90 cm) as compared with 'Sorany' olive cultivar.

Table (1): Effect of Pro.Sol, Folicist and their interactions on plant height (cm) of olive transplant cvs. 'Sorany' and 'Picual'.

Cultivar	Folicist	Pro.Sol			Cultivar * Foli.	Cultivar
		0	100	200		
Sorany	0	96.33 a-c	99.67 ab	91.67 a-c	95.89 ab	94.46 a
	60	103.67 a	90.67 a-c	97.80 a-c	97.38 a	
	120	97.33 a-c	86.00 c	87.00 bc	90.11b	
Picual	0	90.80 a-c	93.47 a-c	92.27 a-c	92.18 ab	94.90 a
	60	97.60 a-c	93.73 a-c	93.73 a-c	95.02 ab	
	120	100.40 ab	95.13 a-c	97.00 a-c	97.51a	
Pro.		97.69 a	93.11 a	93.24 a	Folicist	

Cultivar * Pro.	Sorany	99.11 a	92.11a	92.16 a	
	Picual	96.27 a	94.11 a	94.33 a	
Foli* Pro.	0	93.57 ab	96.57 ab	91.97 ab	94.03 a
	60	100.63 a	92.20 ab	95.77 ab	96.20 a
	120	98.87 ab	90.57 b	92.00 ab	93.81 a

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Resalts indicated that the combination between Pro.Sol and Folicist concentrations displayed that 0mg Pro.Sol.L^{-1} and 60mg. Folicist.L^{-1} appeared to be the most potent treatment, as it gave the highest plant height (100.63 cm).

Results of Pro.Sol and cultivars interactions revealed that the untreated 'Sorany' transplants with Pro.Sol gave the highest value of plant height (99.11cm). However, the lowest plant height was observed with 100mg Pro.Sol.L^{-1}.

The interactions between Folicist and cultivar had asignificant increase in plant height of the 'Picual' transplants when treated with 120mg Folicist.L^{-1}, which gave the highest value (97.51 cm) and the lowest value (90.11 cm) was noticed in 'Sorany' transplants when treated with 120mg Folicist.L^{-1}.

Results of Pro.Sol, Folicist and cultivars interactions indicated that spraying 'Sorany' olive cultivar with 0mgPro.Sol.L^{-1} plus 60mg Folicist.L^{-1} was the most potent treatment which gave (103.67cm) plant height, whereas the lowest plant height (86.00 cm) was recorded for 'Sorany' transplant treated with 100mg Pro.Sol. L^{-1} plus 120mg Folicist.L^{-1}.

2- Leaf number per shoot

In Table (2), it was observed that foliar application of Pro.Sol increased leaf number per shoot, the heighest leaf number value (171.80) produced by transplants treated with 200mg Pro.Sol.L^{-1}.

Olive transplants treated with most of Folicist concentrations substantially increased leaf number, especially at 60mg.L^{-1} as compared to those of the control.

Results of cultivars revealed that 'Sorany' gave the heighest leaf number (203.78) compared with 'Picual' olive cultivar (129.73).

The interactions between Pro.Sol and Folicist denote that the heighest leaf number per shoot (185.73) was observed in transplants received 200mg Pro.Sol.L^{-1} and 0mg Folicist.L^{-1}, whereas the lowest leaf number (144.20) was recorded for transplants treated with 100mg Pro.Sol.L^{-1} and 120mg Folicist.L^{-1}.

Results of cultivars and Pro.Sol concentrations interactions revealed that spraying 'Sorany' at a rate of 200mg Pro.Sol.L^{-1} gave the heighest leaf number (220.24) as compared with other interactions between Pro.Sol and cultivar.

The interactions between Folicist and cultivar had significantly increased leaf number in 'Sorany' transplants when treated with 60mg Folicist.L^{-1} giving the

heighest value (215.53), whereas the lowest value (125.09) was recorded by Picual transplants treated with 120mg Folicist.L^{-1}.

Table (2): Effect of Pro.Sol, Folicist and their interactions on leaf number / shoot of olive transplant cvs. 'Sorany' and 'Picual'.

Cultivar	Foli.	Pro.			Cultivar * Foli.	Cultivar
		0	100	200		
Sorany	0	173.67 a-c	201.93 ab	238.07 a	204.56 a	203.78 a
	60	181.47 a-c	242.73 a	222.40 a	215.53 a	
	120	200.60 ab	172.87 a-c	200.27 ab	191.24 a	
Picual	0	133.73 bc	140.47 bc	133.40 bc	135.87 b	129.73 b
	60	146.60 bc	122.40 c	115.67 c	128.22 b	
	120	138.73 bc	115.53 c	121.00 c	125.09 b	
Pro.		162.47 a	165.99 a	171.80 a	Foli.	
Cultivar * Pro.	Sorany	185.24 a	205.84 a	220.24 a		
	Picual	139.69 b	126.13 b	123.36 b		
Foli.* Pro.	0	153.70 a	171.20 a	185.73 a	170.21 a	
	60	164.03 a	182.57 a	169.03 a	171.88 a	
	120	169.67 a	144.20 a	160.63 a	158.17 a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Results of Pro.Sol, Folicist and cultivars interactions indicated that spraying 'Sorany' olive transplant with 100mg Pro.Sol.L^{-1} and 60mg Folicist.L^{-1} gave the heighest number of leaf (242.73), whereas the lowest number of leaf (115.53) was recorded by 'Picual' transplants treated with 100mgPro.Sol.L^{-1} and 120mg Folicist. L^{-1} .

3- Single leaf area (mm^2)

Results shown in Table (3) reveal that spraying olive transplats with Pro.Sol concentrations resulted had no significant increase in leaf area (mm^2) as compared to the control.

Olive transplants untreated with Folicist gave the heighest value of leaf area (312.31 mm^2)**,** whereas the lowest value (305.21 mm^2) was recorded with 60mg Folicist.L^{-1}.

Results of cultivars revealed that 'Picual' gave the heighest value of leaf area (340.24 mm^2) as compared with 'Sorany' cultivar (274.99 mm^2).

The interactions between Pro.Sol and Folicist denote that the heighest leaf area (347.67 mm^2) was observed in transplants received 100mg Pro.Sol.L^{-1} and 0mg Folicist.L^{-1}, whereas the lowest leaf area (294.58 mm^2) was recorded for untreated transplants.

Table (3): Effect of Pro.Sol, Folicist and their interactions on single leaf area (mm^2) of olive transplant cvs. 'Sorany' and 'Picual'.

Cultivar	Foli.	Pro.			Cultivar * Foli.	Cultivar
		0	100	200		
Sorany	0	270.86 b-d	285.32 b-d	279.22 b-d	278.47 bc	274.99 b
	60	236.99 d	316.83 a-d	285.66 b-d	279.83 bc	
	120	275.29 b-d	255.91 cd	268.79 b-d	266.66 c	
Picual	0	318.30 a-d	410.02 a	310.13 a-d	346.15 a	340.24 a
	60	384.57 ab	298.95 a-d	308.28 a-d	330.60 ab	
	120	315.31 a-d	350.29 a-d	366.28 a-c	343.96 a	
Pro.		300.22 a	319.55 a	303.06 a	Foli.	
Cultivar * Pro.	Sorany	261.05 c	286.02 bc	277.89 bc		
	Picual	339.39 ab	353.09 a	328.23 ab		
Foli.* Pro.	0	294.58a	347.67 a	294.67 a	312.31 a	
	60	310.78 a	307.89 a	296.97 a	305.21 a	
	120	295.30 a	303.10 a	317.53 a	305.31 a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Results of Pro.Sol concentration and cultivar revealed that spraying 'Picual' with Pro.Sol at a concentration of 100mg.L^{-1} gave the heighest value (353.09 mm^2), whereas the lowest leaf area coincided with untreated 'Sorany' olive cultivar (261.05 mm^2).

The interactions between Folicist and cultivar showed that leaf area of untreated 'Picual' transplants gave the heighest value (346.15 mm^2), whereas the lowest value (266.66 mm^2) was recorded from 'Sorany' transplants when treated with 120mg Folicist.L^{-1}.

The interaction between Pro.Sol, Folicist and cultivar caused significant differences in leaf area, the heighest value (410.02mm^2) was recorded for 'Picual' transplants treated with 100mgPro.Sol.L^{-1} and 0mg Folicist.L^{-1}.

4- Leaf fresh weight (mg)

The results in Table (4) revealed that spraying olive transplants with Pro.Sol concentrations resulted had no significant increase in leaf fresh weight as compared to the control.

Folicist had no effect on leaf fresh weight of both cultivars.

Results of cultivars revealed that a non significant increase in leaf fresh weight increment between both cvs.'Sorany' and 'Picual'.

Table (4): Effect of Pro.Sol, Folicist and their interactions on leaf fresh weight (mg) of olive transplant cvs. 'Sorany' and 'Picual'.

Cultivar	Folicist.	Pro.Sol			Cultivar * Foli.	Cultivar
		0	100	200		
Sorany	0	7.79 a	8.18 a	7.89 a	7.96 a	8.30 a
	60	7.95 a	7.79 a	8.73 a	8.16 a	
	120	8.05 a	9.30 a	8.98 a	8.78 a	
Picual	0	9.87 a	7.34 a	9.00 a	8.74 a	8.89 a
	60	8.18 a	9.14 a	8.78 a	8.70 a	
	120	9.68 a	8.54 a	9.47 a	9.24 a	
Pro.		8.59 a	8.39 a	8.81 a	Foli.	
Cultivar * Pro.	Sorany	7.93 a	8.43 a	8.54 a		
	Picual	9.26 a	8.34 a	9.08 a		
Foli.* Pro.	0	8.83 a	7.77 a	8.45 a	8.35 a	
	60	8.08 a	8.46 a	8.76 a	8.43 a	
	120	8.87 a	8.92 a	9.24 a	9.01 a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

The interactions between Pro.Sol and Folicist denote that the heighest leaf fresh weight (9.24mg) was observed in transplants received 200mgPro.Sol.L^{-1} and 120mg Folicist.L^{-1}, whereas the lowest leaf fresh weight (7.77 mg) was recorded for transplants treated with 100mgPro.Sol.L^{-1} and 0mg Folicist.L^{-1}.

Results of Pro.Sol and cultivars interactions revealed that the untreated 'Picual' transplants with Pro.Sol gave the highest value of leaf fresh weight (9.26 mg) as compared with other interactions.

Results indicated that the combination between Folicist and cultivar caused no significant effect on leaf fresh weight.

The interaction between Pro.Sol, Folicist and cultivars interactions denote that the heighest leaf fresh weight (9.87mg) was recorded in untreated 'Picual' transplants, whereas the lowest leaf fresh weight (7.34 mg) was given by transplants treated with 100mgPro.Sol.L^{-1} and 0mg Folicist.L^{-1}.

5- Leaf dry weight (mg)

The results presented in Table (5) revealed that spraying olive transplants with Pro.Sol concentrations had no significant increase in leaf dry weight as compared to the control.

Table (5): Effect of Pro.Sol, Folicist and their interactions on leaf dry weight (mg) of olive transplant cvs. 'Sorany' and 'Picual'.

Cultivar	Foli.	Pro.			Cultivar * Foli.	Cultivar
		0	100	200		
Sorany	0	3.04 a	3.03 a	2.76 a	2.94 a	3.13 a

	60	3.03 a	2.74 a	3.45 a	3.07 a	
	120	3.06 a	3.57 a	3.51 a	3.38 a	
Picual	0	3.67 a	2.56 a	3.12 a	3.12 a	3.15 a
	60	2.72 a	3.30 a	3.13 a	3.05 a	
	120	3.70 a	2.88 a	3.28 a	3.29 a	
Pro.		3.20 a	3.01 a	3.21 a	Foli.	
Cultivar * Pro.	Sorany	3.04 a	3.11 a	3.24 a		
	Picual	3.36 a	2.91 a	3.18 a		
Foli.* Pro.	0	3.35 a	2.79 a	2.94 a	3.03 a	
	60	2.87 a	3.02 a	3.29 a	3.06 a	
	120	3.38 a	3.23 a	3.40 a	3.33 a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Olive transplants treated with Folicist concentrations substantially increased leaf dry weight, especially at 120mg.L^{-1} as compared to control.

Results of cultivars revealed that there was no significant increase in leaf dry weight but 'Picual' gave the heighest leaf dry weight (3.15 mg) as compared with 'Sorany' olive cultivar.

The interactions between Pro.Sol and Folicist denote that the highest leaf dry weight (3.40 mg) was observed in transplants received 200mg Pro.Sol.L^{-1} and 120mg Folicist.L^{-1}, whereas the lowest leaf dry weight (2.79 mg) was recorded for transplants treated with 100mgPro.Sol.L^{-1} and 0mg Folicist.L^{-1}.

Results of Pro.Sol and cultivars interactions revealed that the untreated 'Picual' transplants with Pro.Sol gave the highest value of leaf dry weight (3.36 mg). However, the lowest leaf dry weight was observed for Picual transplants treated with 100mgPro.Sol.L^{-1}.

Results indicated that the combination between Folicist and cultivar caused no significant effect on leaf dry weight.

Results of Pro.Sol, Folicist and cultivars interactions indicated that spraying 'Picual' transplants with 0mg Pro.Sol.L^{-1} plus 120mg Folicist.L^{-1} was the most potent treatment giving (3.70 mg) leaf dry weight, whereas the lowest leaf dry weight was recorded for 'Picual' transplants treated with 100mg Pro.Sol.L^{-1} plus 0mg Folicist.L^{-1}.

Discussion:

Cultivars:

It's clear from most Tables that the vegetative growth characteristics significantly differed between the two cultivars. The differences between the cultivars in vegetation growth characteristics such as (plant height, leaf number,

single leaf area, leaf fresh weight, and leaf dry weight) may be ascribed to the differences in genotype characteristics for root growth, nutrient absorption efficiency and photosynthesis process **(**Eryüce and Püskülcü, 1995 and Jorda et al., 1999**).** In addition, the genetic integrity of the plant species might influence particular nutrient uptake efficiency (Popovic et al., 1999). Then, these differences in nutrient uptake efficiency between cultivars may cause differences in vegetative growth characteristics.

Also, the differences in growth vigor between the two cultivars may be attributed to the response of different cultivars to the local environmental conditions according to the genetic variation between the cultivars (Gaafar and Saker, 2006 and Khalifa, 2007).

It is clear from studied parameters that the effect of Pro.Sol and Folicist on vegetative growth characteristics improved all parameters, the results may be due to the role of essential nutrients in plants such as photosynthesis reactions, nucleic acid metabolism, protein and carbohydrate biosynthesis due to increased leaf mineral content (Hafez and El-Metwally, 2007).

Potassium takes part in many important processes, regulating the opening and closing of stomata, the transport of organic and inorganic ions within the plant (Elloumi et al., 2009 and Ibrahim 2005)

Conclusions:

It's clear from this study that

1- Pro.Sol fertilization improved all vegetative growth characteristics for both cultivars of olive transplant cv. Sorany and Picual.
2- Foliar spraying of Folicist with high concentration increased all vegetative growth characteristics for both cultivars of olive transplants cv. Sorany and Picual.
3- Olive transplants of cv. Picual were preferable compared with cv. Sorany.
4- Interaction between Pro.Sol fertilization and Folicist spraying in high levels and both cultivars increased all vegetative growth characteristics.

Recomindations:

Depending on the conclusions mentioned above, the following points of view can be recommended:

1- Conducting other studies on other olive cultivars and spraying high concentrations of Pro.Sol and Folicist.
2- Conducting anatomical studies for the studied cultivars to know the effect of the used material on tissues structure.

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تأثير الصنف، بروثول، فوليسيست وتفاعلاتها على بعض النمو الخضري لشتلات الزيتون (*Olea europea* L.) لصنفي سوراني وبيكول (ب)

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كلية التقنية الزراعية حلبجة / جامعة السليمانية التقنية

الخلاصة

تنفذت هذه التجربة خلال موسم النمو 2014 في محطة مشتل بكرجو في محافظة السليمانية/ اقليم كردستان / العراق. تم اختيار شتلات متجانسة و خالية من الامراض للزيتون (*Olea europea* L.) صنفي سورانى و بيكوال و بأعمار سنتين. بداءت التجربة في (23 مايس 2014) حيث زرعت الشتلات في أكياس النايلون سعة (5 كغم) تم ملئها بالرمل. وذلك لدراسة تأثير ثلاثة تراكيز من Pro.Sol (صفر و 100 و 200ملغم. لتر$^{-1}$) و ثلاثة تراكيز من Folicist (0 و 60 و 120 ملغم. لتر$^{-1}$) و تداخلاتها على بعض صفات النمو الخضري لشتلات صنفي سورانى و بيكوال. تم تنفيذ تجربة العاملية بواقع ثلاث مكررات حسب تصميم القطاعات العشوائية الكاملة (RCBD) وذلك بزراعة خمس شتلات لكل وحدة تجريبية. وتم الرش بـــ Pro.Sol و Folicist في 25 مايس و كررت عملية الرش بنفس التراكيز في 25حزيران. تم تحليل البيانات بنظام SAS (SAS، 1996) واختبرت المتوسطات بطريقة دنكن المتعدد الحدود و على مستوى معنوية 5%.

تم اختصار النتائج كما يلي: صنف بيكوال تفوق معنويا على صنف السورانى في معظم صفات المدروسة ماعدا عدد الاوراق في الفرع، وتفوق سماد Folicist على Pro.Sol فى الصفات المدروسة ماعدا ارتفاع النبات و مساحة الورقة. و التداخل بين Pro.Sol و Folicist و صنف بيكوال تفوق معنويا في صفة مساحة الورقية، في حين التداخل بين Pro.Sol و Folicist و صنف سوراني أدى الى تفوق معنوي في صفتي ارتفاع النبات و عدد الاوراق لكل فرع.