The Effect of Phosphate Fertilizer Starter Solution on Growth of Two Tomato (*Lycopersicon Esculentum* Mill) Varieties in Sandy Soil

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Abstract

A field experiment is conducted during the growing season of 2012 - 2013 on a sandy loam soil at Al-Berjsia researches station / Ministry of Agriculture , Basrah province , south of Iraq . The aim of study is to determine the effect of phosphate fertilizer starter solution on the growth of Two Tomato (*Lycopersicon Esculentum* Mill) varieties (Hotuf and Speedy) and P-uptake . Phosphate fertilizer as consternated super Phosphate (CSP) is applied at level 120 Kg P ha^{-1} . An equivalent of 0 , 0.05 , 0.10 and 0.20 % of Phosphor level are added as starter solution either at transplanting time or three days after transplanting . The remaining of Phosphorus level was applied to soil at two doses . Percentage of dead seedling , plant height , number of leaves $plant^{-1}$, number of branches $plant^{-1}$, number of flower clusters $plant^{-1}$, shoot and root dry weight , P concentration in leaves and P-uptake by plant are investigated . The results show that addition of CSP starter solution significantly decreases the percentage of dead seedling of compared with the control treatment . Plants received Phosphor starter solution show a higher growth parameters and P-uptake as compared with control treatment plants . Increasing the level of Phosphor starter solution from 0 to 0.20 % decreases percentage of dead seedling by 90.1 % and increased plant height by 19.23 % , number of leaves by 33 % , number of branches by 23.52 % , number of flower clusters by 69.24 % , shoot dry weight by 183.1 % , root dry weight by 175 % , P concentration by 60.8 % and P-uptake by 309.7 % . Comparing between two tomato varieties ,results show that Speedy tomato variety is more tolerant to transplanting and gives a higher growth and P-uptake , the results show also tomato seedlings received starter solutions at three days after transplanting time appear more resistant to soil shuck of transplanting than those plants received starter solution at transplanting.

Keywords : P- Starter Solution , Transplanting , Tomato , Sandy Soil .

INTRODUCATION

Tomato crop (*Lycopersicun Esculentum* L.) is an important vegetable crops locally and in all the world , planted extensive areas of high nutritional value, whether fresh or packed, although the area under cultivation of this crop in Iraq and Basra, which amounted in Basra

limits (140000 Donms), but the total yield for the season Agricultural did not exceed more than (225,000 tons) (Basra Agriculture Directorate , 2014) is still low compared to the productivity of the developed producing countries. Increased demand for tomato crop , forcing a lot of farmers to follow the best and most modern scientific methods and techniques in the use of mineral fertilizers added to this crop in order to reach a better growth of the plant and therefore higher production (Hasaan , 1998).

Conduct new methods in nutrition and fertilizer and used essential is the important factor to success planting seeds and improved plant growth and increased its adaptation to field conditions when its adding at the right demanded by plants (Boamah *et al.*, 2011) . Because the soil in west of Basrah was sandy soils , so its infertility and have a bad physical and chemical properties such as higher salinity and its depend on salinity ground water to irrigate plants , its caused field of growing plants due to unbalancing nutrients in plant and decreased available nutrients in soil solution , and its effect on growth and total yield .(Mohsen, 1997).

Phosphate fertilizers are the most important fertilizers to plant growth because these content of Phosphorus element and it role in physiological operations in plant and increased plant content of starch , carbohydrates , sugars , cell walls , proteins and amino acids . (Mahajan, G. and K.G. Singh, 2006) . But the problem when addition phosphate fertilizers direct to soil caused an adsorption and fixation phosphor and increased immobile phosphor in soil , unless added in best shape , quantity and time under new methods . It's important to try to maintain and improved soil plant conditions to make plant recovery more rapidly from the shock of transplanting . This can be accomplished through addition of starter solution . Starter solution defined as a dilute solution of nutrients placed around plants roots at transplanting time , then plant roots should reached it very soon so that the crop will be given a good early start (Mohammed 2010) . Considering the above concepts , the present investigation was carried out to study the effect of different levels and time of application of phosphate starter solutions on growth , P - uptake dry Wight and P-concentration of Two varieties of tomato grown in sandy soil .

MATERIAL AND METHODS

A field experiment was conducted during the growing season of 2012 - 2013 at Al-Bejsia researches station farm related to Agriculture Ministry , Al-Zubier district , Basrah province , south of Iraq . Soil of experimental site classified as in order :Entisol , Typic quartzi Pasmment (Buringh , 1960) . This study was carried out to investigate the effect of starter solution of phosphor fertilizer on growth and P-uptake by two cultivated varieties (Hotuf and Speedy) of tomato plant (*Lycopersicon esculentum* Mill.) . The two tomato varieties are

American hybrids common use in this region , highly productive and resistant to stresses . Soil of the experimental shown in table (1) : pH and EC were determined with a glass electrodes (soil : ratio, 1:1), and CaCO3 was determined by oxidation with 1 *N* HCl (Page *et al.*, 1982). Cation exchange capacity was determined as described by Papanicolau (1976). Organic C was determined by method of Walkly and Black as described in Page *et al* (1982). Available P was determined by 0.5 *M* NaHCO3 carried out as method of Murphy and Riely (1962), respectively Soil texture was performed by pipette method as described by Black (1965).

Table (1) : Some properties of the used soil (0 - 40 cm depth) and irrigation water .

	EC dSm^{-1} 1:1	pH 1:1	CaCO3 gm Kg^{-1}	CEC $Cmol^{+}$ Kg^{-1}	OM gm Kg^{-1}	Available P Ug gm $soil^{-1}$	Texture
Soil	4.5	7.04	111.9	6.34	0.12	8.16	Sandy loam
Water	9.35	7.62	---	---	---	---	

Experimental design was factorial with three factors (Levels of starter solution X Time of application X Tomato variety) . Each treatment was performed in triplicate . Prior to planting field was plowing perpendicularly and treated with cattle manure residual of 4 tons ha^{-1} . Each plot was with 4 m long and 40 cm width planted with 20 plants . Drip irrigation was applied and the planting was in double rows under plastic low tunnels system .

Seeds of Hotuf and Speedy were sown in peat growing media in mid-September 2012 and transplanting to permanent field at 25th October . All plots received Urea fertilizer (46 % N) at rate of 180 Kg N ha^{-1} in three doses , one at soil preparing , second dose after one month of transplanting , and other after Two month of transplanting . Potassium as potassium Sulphate (43 % K) at rate of 120 Kg K ha^{-1} in two doses , one at soil preparing , and other after one month of transplanting . Concentrated Super Phosphate (CSP) (52 % P2O5) at rate of 120 Kg P ha^{-1} Kg N ha^{-1} in two doses , one at soil preparing , second dose were added as an equivalent of 0 , 0.05 . 0.10 and 0.20 % of Phosphor starter solution either at transplanting time or 3 days after transplanting . Starter solutions were prepared by dissolving the desired amount of phosphor in adequate volume absolute water and added the solution filtrate of dissolve phosphor fertilizer to bed plants on soil surface at the end of adding day .

All normal agricultural processes of Tomato plants were practiced as usually followed in tomato commercial production fields in west of Basrah . Five days after transplanting , percentage of dead seedlings was counted in regard to total plants of the plot . Four plants

in each plot were selected and the average of plants height , number of branches , number of leaves , number of flowers clusters was recorded at 3 , 7 and 11 weeks after transplanting . Samples of selected plants were harvested at 77 days after transplanting , dried at 70 C° , then shoot and root dry weight were recorded . A wet digestion of grinding dry shoot were operated by Sulfuric - berchloric acids as described by Cresser and Parsons (1979) and determined phosphor concentration of using spectrophotometer on 700 nm .

Phosphor uptake by plant shoot was calculated by multiplying with phosphorus concentration . All the obtained data were subjected to statistical analysis of variance , and difference among the mean were compared through RLSD test .

RESULTS AND DISSCISION

Data in table (2) showed the percentage of dead seedling at Five days after transplanting to permanent in field in relation to starter solutions of Phosphorus . Data showed that addition of phosphate starter solutions significantly decreased the percentage of dead seedling . On an average , increasing starter solution levels from 0 to 0.20 % decreased gradually and significantly percentage of dead seedling from 8.81 to 0 % . Those decrease were statistically significant at the two time of application and at Two tomato verities . At control treatments (no addition of phosphate starter solutions) tomato seedling were negatively influenced by transplanting in field due to that transplanting have a limited root system and consequently a limited capacity for adsorption of water and nutrients (Al- Omran *et al*., 2010) . At the same time , irrigated with saline water (more than 9.35 dSm^{-1} all over tomato growth season in west Basrah) suddenly in field may cause salt damage to tomato seedling resulting in seedling death (Mohammed , 2010) .

On the other hand , addition of phosphate starter solutions significantly decreased number of dead seedling and increased plant growth parameters and P-uptake . This reason may be referred to the role of phosphor starter solutions to make plants more tolerance from soil shock of transplanting (Ahmed , 2014). Between tomato varieties , Hotuf had the lower percentage of dead seedlings of 3.69 and 2.74 % , while Speedy had the higher percentage of dead seedlings of 4.22 and 4.22 % for phosphate addition at transplanting and 3 days after transplanting respectively . No significant differences on dead seedling between the two tomato varieties , were obtained at higher starter solutions level meaning that the two varieties can tolerate transplanting shock in fields when receiving starter solutions. Percentage of dead seedling is an important characteristics when selecting a variety for transplanting tolerance . The reason that

Table (2) : Effect of level and application time of CSP starter solutions on % dead seedling after 6 days of transplanting

CSP Level%	Hotuf			Speedy			Mean
	T*	3 dT*	Mean	T*	3 dT*	Mean	
0	7.15	7.15	7.15 c+	8.47	8.47	8.47	8.81 A
0.05	3.82	1.91	2.86	6.53	6.53	6.53	4.69 B
0.10	3.82	1.91	2.86	1.91	1.91	1.91	2.38 C
0.20	0	0	0	0	0	0	0 D
Mean	3.69	2.74		4.22	4.22		

* CSP Starter solution added either at time of transplanting (T) or 3 days after transplanting (3dT).
+ Different letters show significant differences at 0.05 level (capital letters from main effects , and small letters for interactions).

tomato seeds often are too expensive and that transplanting needs special conditions and requirements , which are normally costly . Table (2) shown that Hotuf variety more tolerant (about 31.46 %) to transplanting than Speedy variety . The Maximum percentage of dead seedlings were observed at addition of starter solution at time of transplanting (3.95 %) and the minimum percentage of dead seedlings were observed at 3 days after transplanting (3.48 %) . It was clearly showed that were no significant difference on dead seedlings between varieties when using starter solutions at time of transplanting while there were significant difference when starter solutions added 3 days after transplanting (Ahmed et al., 2014) .
Plant height at first period after transplanting is one of the most important characters for transplanting effect , because plant height provides an important attention to plant response in new field environment . Fig. (1) showed increasing in plant height after 3, 7 and 11 weeks after transplanting compared with control treatment at transplanting and after 3 days after transplanting for Two tomato varieties respectively. As regarding of application time or varieties , increasing CSP levels addition as starter solutions from 0 to 0.05 , 0.1 and 0.2% significantly increases plant height from 52.33 to 56 , 62.33 and 69 cm respectively at 3 days after transplanting , and from 52.33 to 55 , 66.1 and 66.66 cm respectively at transplanting for Hotuf variety after 77 days after planting . For Speedy variety , Fig. (1) show that increasing CSP levels addition as starter solutions from 0 to 0.05 , 0.1 and 0.2% significantly increases plant height from 53.66 to 59.66 , 65 and 69 cm respectively at 3 days after transplanting , and from 53.66 to 60.33 , 65 and 68 cm respectively at transplanting after 77 days after planting (about 19.23 %) (Ali et al., 2012) .
Although the two varieties showed no significant differences in plant

height , the higher values in all sampling times were usually obtained in variety of Speedy compared with Hotuf variety (Fig. 1) . These slight differences between varieties may attributed to slight differences at first days after transplanting especially in control treatment , meaning that our varieties were more sensitive to transplanting in field in term of plant height (Mohammed , 2010).

Tomato seedling received CSP starter solutions at 3 days after transplanting showed significantly higher plant height in contrast to those received CSP starter solutions at transplanting . The averages of tomato plants height at the two application times were 69 and 67.33 cm , respectively (Feleafel and Mirdad , 2014 and Kamel et al., 2015) .

Fig. (2) showed increasing in number of branches plant^{-1} after 3 , 7 and 11 weeks after transplanting compared with control treatment at transplanting and after 3 days after transplanting for two tomato varieties respectively . As regarding of application time or varieties , increasing CSP levels added as starter solutions from 0 to 0.05 , 0.1 and 0.2% significantly increases number of branches plant^{-1} from 14 to 18.66 , 20.33 and 22.66 branches plant^{-1} respectively at 3 daysafter transplanting , and from 14 to 18.33 , 20 and 21.66 branches plant^{-1} respectively for Hotuf variety after 77 days at transplanting . For Speedy variety , Fig. (2) show that increasing CSP levels added as starter solutions from 0 to 0.05 , 0.1 and 0.2 % significantly increases number of branches plant^{-1} from 14 to 18.66 , 20.33 and 22.66 cm respectively at 3 days after transplanting and from 14 to 18.33 , 20 and 21.66 branches plant^{-1}at transplanting respectively , after 77 days after planting (Ali et al., 2012) . Although the two varieties showed.

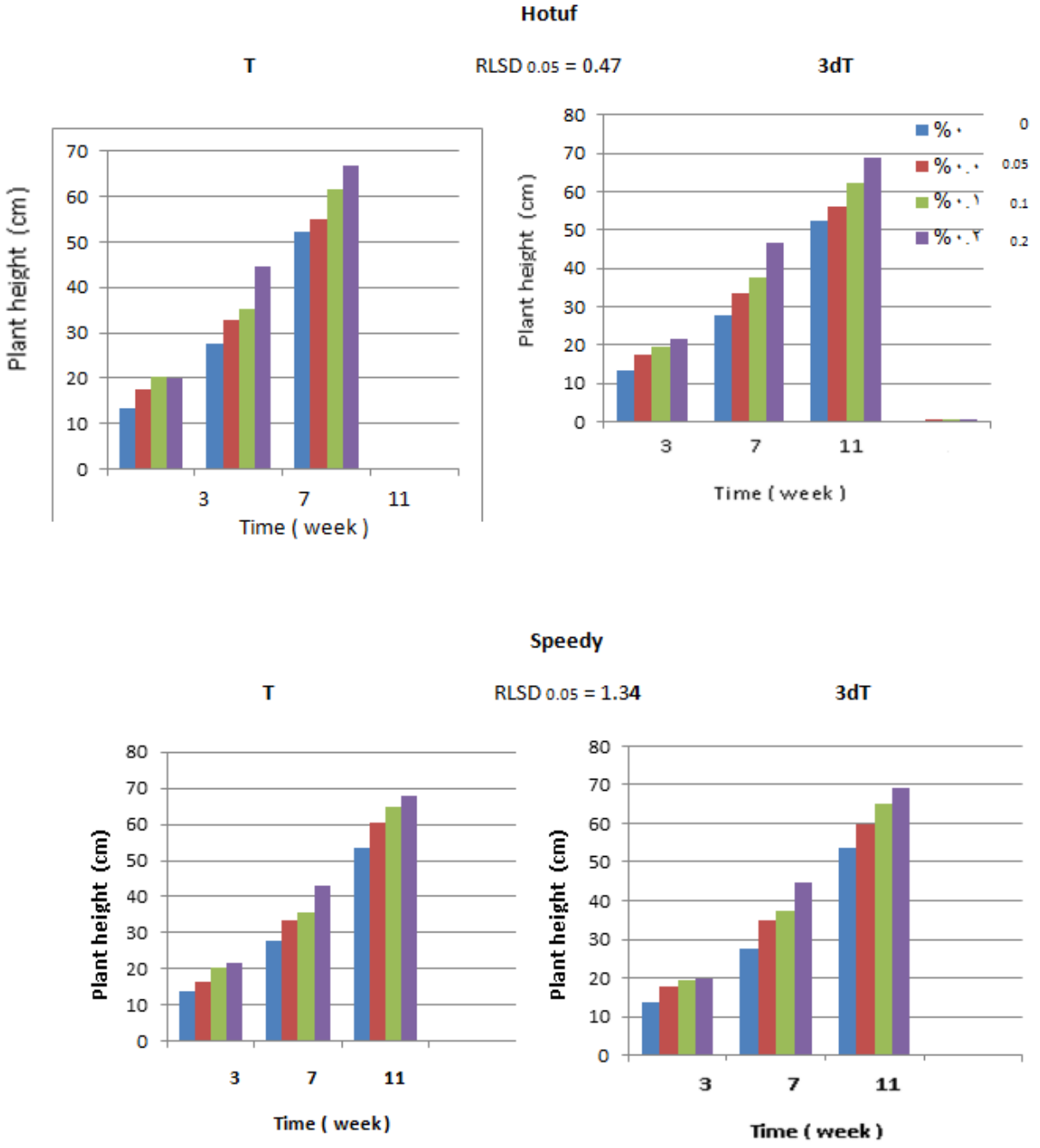

Fig. (1): Effect of levels and application time of Phosphor starter solution on height of Two Tomato varieties through 77 days after transplanting .

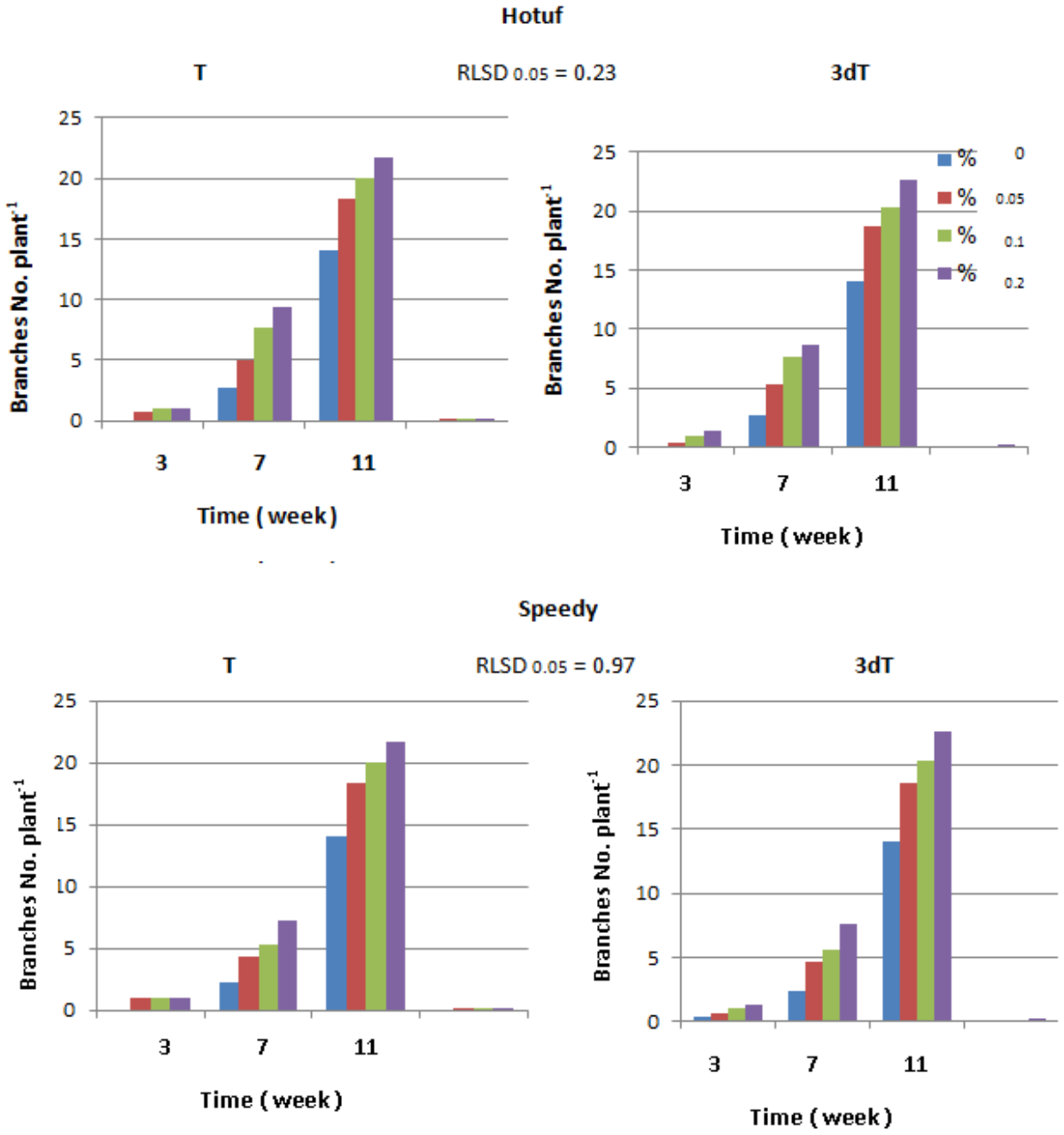

Fig. (2): Effect of levels and application time of Phosphor starter solution on Branches No. Plant^{-1} of Two Tomato varieties through 77 days after transplanting .

no significant differences in number of branches plant^{-1}, the higher values in all sampling times were usually obtained in variety of Speedy compared with Hotuf variety (Fig. 2) . these slight differences between varieties may attributed to slight differences at first days after transplanting especially in control treatment , meaning that our varieties were more sensitive to transplanting in field in term of branches number plant^{-1}.

Tomato seedling received CSP starter solutions at 3 days after transplanting showed higher number

of branches plant^{-1} in contrast to those received CSP starter solutions at transplanting . The averages of number of branches plant^{-1} at the two application times were 22.66 and 21.66 , respectively (Feleafel and Mirdad , 2014) .

Fig. (3) showed increasing in number of leaves plant^{-1} after 3 , 7 and 11 weeks after transplanting compared with control treatment at transplanting and after 3 days after transplanting for Two tomato varieties respectively . As regarding of application time or varieties , increasing CSP levels added as starter solutions from 0 to 0.05 , 0.1 and 0.2 % significantly increases number of leaves plant^{-1} from 65 to 72.66 , 81.66 and 90 respectively at 3 days after transplanting , and from 65 to 71 , 81.66 and 88.66 number of leaves plant^{-1} respectively at transplanting for Hotuf variety after 77 days after planting . For Speedy variety , Fig. (3) show that increasing CSP levels added as starter solutions from 0 to 0.05 , 0.1 and 0.2 % significantly increases number of branches plant^{-1} from 64.66 to 67.66 , 74.66 and 86.33 respectively at 3 days after transplanting and from 64.66 to 68.33 , 74.33 and 84.66 number of leaves plant^{-1} at transplanting respectively , after 77 days after planting (about 23.52 %) (Feleafel and Mirdad , 2014) .

Compared between two varieties , Fig. (3) showed no significant differences in number of leaves plant^{-1}, the higher values in all sampling times were usually obtained in variety of Speedy compared with Hotuf variety . these slight differences between varieties may attributed to slight differences at first days after transplanting especially in control treatment , meaning that our varieties were more sensitive to transplanting in field in term of branches number plant^{-1} .

Tomato seedlings received CSP starter solutions at 3 days after transplanting showed higher number of leaves plant^{-1} in contrast to those received CSP starter solutions at transplanting . The averages of number of leaves plant^{-1} at the two application times were 88.16 and 85.66 , respectively (Razzaq , 2013).

Data in Table (3) showed that applications of CSP starter solutions significantly effected on Cluster No. plant^{-1} , shoot dry weight , root dry weight , P concentration in leaves and P - uptake of tomato plants as compared to control . Table (3) showed that increasing starter solution of CSP levels from 0 to 0.2 % increased Cluster No. plant^{-1} by 69.24 % , shoot dry weight by 183.1 % , root dry weight by 175 % , P concentration by 60.86 % and P - uptake by 309.74 % . (Feleafel M., N. and Z. M. Mirdad , 2014) .

Higher growth parameters and P - uptake were obtained at Hotuf variety relative to Speedy variety . Mean number of Cluster , shoot dry weight , root dry weight , P consternation and P - uptake were 16.58 Cluster No. plant^{-1} , 1.60 gm plant^{-1} , 0.21gm plant^{-1} , 3.36 gm Kg^{-1} and 4.78 mg plant^{-1} for Hotuf variety , respectively , and were 16.82 Cluster No. plant^{-1} , 1 gm

plant^{-1} , 0.15 gm plant^{-1} , 3.13 gm Kg^{-1} and 3.35 mg plant $^{-1}$ for Speedy variety , respectively .

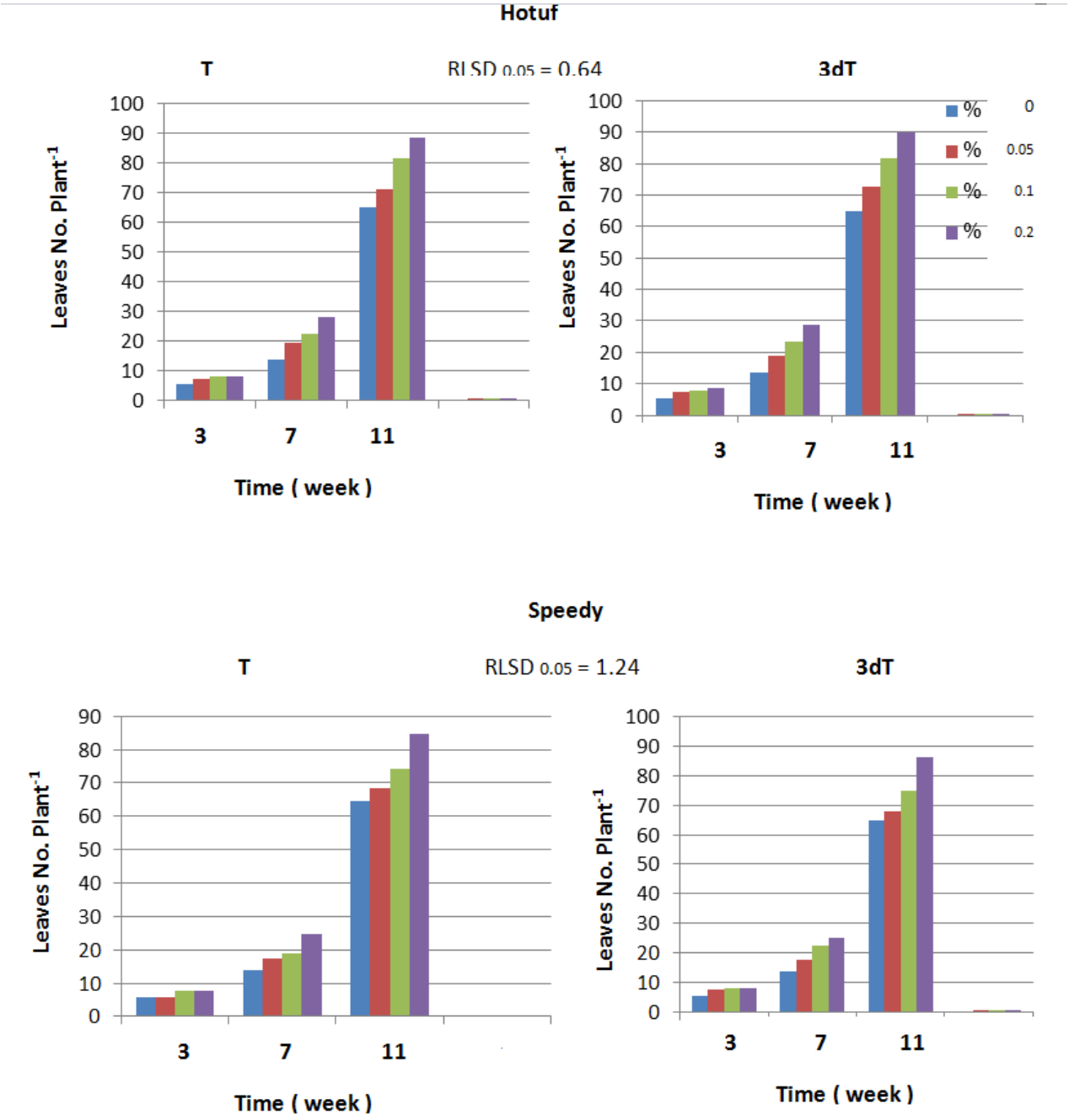

Fig. (3): Effect of levels and application time of Phosphor starter solution on Leaves No. Plant^{-1} of Two Tomato varieties through 77 days after transplanting .

Higher growth parameters and P - uptake associated with Hotuf variety received 0.2 % CSP starter solutions among other treatments except that of Cluster No. plant^{-1} compared with Speedy variety received 0.2 % CSP starter solutions . However , two varieties showed higher growth response to starter solutions of CSP compared with control treatment (Hussam *et al.*, 2012 , Kamil *et al.*, 2015 , Mohsen , 2000) .

As far as time of application is concerned , Table (3) showed the higher growth parameters and P - uptake of tomato plants were produced by plants receiving CSP starter solutions at 3 days after transplanting compared to those of plants receiving starter solutions at transplanting . These results show similarities to findings determined for % of dead seedlings .

This results can explained by resistance of young plants to shock of salinity in water irrigation (Table 1) and receiving starter solutions after adaptation to soil conditions . (Havilan , 2005 , Gibson , 1983).

Table (3): Effect of levels and application time of CSP starter solutions on plant growth parameters and P-uptake of Two tomato varieties after 77 days of planting .

CSP Level%	Hotuf			Speedy			Mean
	T*	3 dT*	Mean	T*	3 dT*	Mean	
Cluster No. plant^{-1}							
0	12.00	12.00	12.00a+	12.33	12.33	12.33a	12.16A
0.05	15.66	16.33	15.99b	15.00	15.33	15.16b	15.57B
0.10	18.33	18.66	18.49c	18.33	18.66	18.49c	18.49C
0.20	19.33	20.33	19.83c	21.00	21.66	21.33d	20.58D
Mean	16.33a	16.83a		16.66a	16.99a		
Shoot dry weight (gm plant^{-1})							
0	0.89	0.89	0.89a	0.32	0.32	0.32a	0.65A
0.05	1.45	1.52	1.48b	0.75	1.11	0.43a	1.12B
0.10	1.69	2.30	1.99b	1.20	1.39	1.29b	1.64C
0.20	1.57	2.51	2.54c	1.20	1.76	1.48b	1.84C
Mean	1.40b	1.81a		0.86b	1.14b		
Root dry weight (gm plant^{-1})							
0	0.11	0.11	0.11a	0.03	0.03	0.03a	0.08A
0.05	0.20	0.13	0.16a	0.06	0.19	0.12b	0.15A
0.10	0.26	0.31	0.28b	0.11	0.43	0.27c	0.32C
0.20	0.21	0.31	0.26b	0.15	0.20	0.18b	0.22B
Mean	0.19b	0.22b		0.09a	0.21b		
P - Concentration (gm Kg^{-1})							
0	2.53	2.53	2.53a	2.53	2.53	2.53b	2.53A
0.05	2.73	2.76	2.74a	2.70	3.16	2.93b	2.87A
0.10	3.10	3.93	3.51b	3.03	3.23	1.56a	3.06B
0.20	4.10	4.40	4.25c	3.80	3.96	3.88c	4.07C
Mean	3.11a	3.61c		3.02a	3.24b		
P - uptake(mg plant^{-1})							

0	2.25	2.25	2.25a	0.81	0.81	0.81a	1.54A
0.05	3.95	4.19	4.07b	2.06	3.51	2.78b	3.47B
0.10	4.86	7.04	5.95c	3.64	4.49	4.07c	5.01C
0.20	5.74	7.97	6.85d	4.56	6.97	5.76d	6.31D
Mean	4.20c	5.36d		2.76a	3.95b		

* CSP Starter solution added either at time of transplanting (T) or 3 days after transplanting (3dT).
+ Different letters show significant differences at 0.05 level (capital letters from main effects , and small letters for interactions).

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تأثير اضافة محاليل بادئة من السماد الفوسفاتي نمو صنفين من الطماطم (*Lycopersicon Esculentum* Mill) في الترب الرملية

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كلية الزراعة / جامعة البصرة

الخلاصة

نفذت تجربة حقلية خلال موسم النمو 2012 - 2013 في تربة رملية بمحطة بحوث البرجسية التابعة لوزارة الزراعة في محافظة البصرة جنوبي العراق لدراسة تأثير أضافة محاليل بادئة من السماد الفوسفاتي في نمو وأمتصاص الفوسفور لصنفين من الطماطم (Hotuf و Speedy) . أضيف سماد السوبر فوسفات المركز (CSP) بمستوى 120 كغم هكتار $^{-1}$ ، وحضرت محاليل بادئة بما يكافئ صفر و 005 و 0.10 و 0.20 % من مستوى الفوسفور المضاف . أضيفت المحاليل بموعدين أما عند موعد نقل الشتلات مباشرة الى الحقل أو بعد ثلاثة أيام من النقل و أضيف باقي التوصية السمادية من الفوسفور الى التربة بجرعتين . قيست النسبة المئوية للبادرات الميتة ، أرتفاع النبات ، عدد الاوراق ، عدد الافرع ، عدد النورات الزهرية بالنبات ، الوزن الجاف للجزئين الخضري والجذري ، تركيز الفوسفور في الاوراق والكمية الممتصة من الفوسفور . بينت النتائج أن أضافة المحاليل البادئة من الفوسفور أدت الى أنخفاض معنوي في عدد البادرات الميتة مقارنة بمعاملة المقارنة . كما بينت النتائج أن النباتات المعاملة بالمحاليل البادئة أعطت أعلى صفات نمو وأمتصاص للفوسفور مقارنة بنباتات معاملة المقارنة . زيادة مستوى الاضافة من المحاليل البادئة من صفر الى 0.20 % ادى الى أنخفاض معدل البادرات الميتة بنسبة 90.1% ، ارتفاع النبات بنسبة 19.23 % ، عدد الاوراق بنسبة 33 % ، عدد الافرع بنسبة

23.52 % ، عدد النورات الزهرية بنسبة 69.24 % ، الوزن الجاف للجزء الخضري بنسبة 183.1 % ، الوزن الجاف للجزء الجذري بنسبة 175 % ، تركيز الفوسفور بنسبة 60.86 % والكمية الممتصة من الفوسفور بنسبة 309.7 % . وجد من خلال المقارنة بين الصنفين أن صنف هتوف أكثر تحمل للنقل للحقل الدائم وأمتصاص الفوسفور . كما بينت البيانات ان البادرات التي استلمت محاليل بادئة بعد ثلاثة ايام من النقل اكثر مقاومة لصدمة تربة الحقل عند النقل مقارنة بالبادرات التي استلمت محاليل بادئة أثناء النقل .

الكلمات المفتاحية : p المحلول البادئ ، النقل النباتي ، الطماطة ، التربة الرملية .