EFFECT OF PHOSPHOROUS FERTILIZER AND FIVE VARIETIES ON THE QUANTITY AND QUALITY OF SUGAR BEET (*Beta Vulgaris* L.)

Salih .M. Al-Rashidi
Dept . of Soil and Water , Collage Agric. and Forestry,Mosul univ. Iraq

ABSTRACT

A field Experiments in two agricultural locations were carried out to evaluate three levels of phosphorous fertilizer (60,80,120)Kg P/ha, as super phosphate and five varieties of sugar beet, Monogerm (Vero, Rosana, Rosa) and, Multigerm (Gitane, Monterosa). Results showed the yield of root (ton/ha) increased significantly as the fertilizer increased, which gives (20. 3 % ,24.6%) when compared with first level added of phosphorous fertilizer respectively , The root sugar also increased as compared to the first level (0.65%,0.89%) respectively in both locations, Monogerm (Vero, Rosana, Rosa) gave a high yield of sugar and purity when compared with the Multigerm ,Vero surmount to the others Monogerm Rosana and Rosa at the two locations .So phosphorous fertilizer and the Monogerm of the sugar beet increased the quantity and Improved quality at the two locations under Iraqi conditions

INTRODUCTION

Sugar beet (*Beta Vulgaris* L.) related to the Chenopodiaceae family is an important plant in sugar production. Sugar is considered as consuming substance in the world societies. Even the Molasses, which is the main byproduct, filtered substance of sugar industry is an important matter used for animal's nutrition, in addition to obtain alcohol and acetone as sub products (cattanach *et al.*, 1993).Sugar industry started in Iraq after building a factory in Mosul in Northern Iraq at the begging of the sixteenth of the last decade century. Many problems faced this industry from the beginning and continued till now. The main problems were how to in crease the yield and the quality, By facing the mechanization problems, the fertilizer recommendations and the suitable varieties of sugar beet which gives higher quantities and good qualities under Iraqi conditions specially during spring sowings (Alrashidi 2001, Kuldip, 2009).Sugar beet quality involves two concepts: the percent sucrose , and the level of impurities in the roots , both of which affect sucrose extraction by the processor. Production of high quality sugar beets is especially important to growers whose payment is based on the extractable sucrose content of their beets (Shallenbarger 1995; Draycott and Christonson, 2003; ,Ancuta, 2008). Plants need Phosphorus for growth, utilization of sugar and starch, photosynthesis, nucleus formation and cell division, fat , and albumen formation. Phosphorus compounds are involved in the transfer and storage of energy within plants. Energy from photosynthesis and the metabolism of carbohydrates is stored in phosphate compounds for later use in growth and reproduction (Barker and Pilbeam, 2007 Marchnar, 2008), Phosphorus is readily translocated within the plants, moving from older to younger tissues as the plant form cells and develops roots, stems and leaves. Sugar roots yield in check plot (No P fertilizer) was about 56.97 ton/ha, while increased to 84.4 ton/ha after the addition of 75 kg P2O5 / ha (Smith et al. 2002).Adequate P results in rapid growth and earlier maturity, which

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is important in areas where frost is a concern. Frequently, the quality of vegetative growth is improved. A good supply of P to sugar beet has been associated with increased roots growth, which means the plant can explore more soil for nutrients and moisture. These will reflect to improve quantity and quality of sugar beet other wise a deficiency of P will slow overall plant growth.(Mengle and Armstrong, 1987; Jaszczolt, 2000; Lamb et al. 2001), Varieties consider as important factor witch depend on the environmental conditions (Abdal, 2005). The main problems of using phosphate fertilizers in calcareous soils is the availability P to plants uptake and utilization impaired in these soils due to the formation of poorly soluble (Ca-P) minerals (Hopkins and Ellsworth, 2005). So adding fertilizer P at normal rates and choosing the suitable Crops and Varieties may incurs these problems to reach the economic yields with higher Quantities and best Qualities of Sugar Beet productions. The present study might give some answers about these questions regarding the phosphate fertilization requirements for Iraqi calcareous soils.

MATERIALS AND METHODS

A field experiment conducted in two locations in the Iraqi fields the first at Hawiga (L1) About 90 Km East- North Mosul city and the other in Rabeia (L2) about 80 Km North- West of Mosul city , the two locations considered as a famous area in sugar beet production . Some chemicals and physical soil properties of these regions are showed in Table (1) Routine Analysis' - Available P ,K and N with total $CaCO_3$ and P^H with Organic matter (page etal 1982) the experiment designed as a Split plot with (R.C.B.D) in a factorial treatments, Three levels of phosphate fertilizer levels (PFL) P1 , P2 and P3 (60,90,120) Kg P/ha respectively ,in a main plot (there is no control (Zero P) treatment- because this crop not growing with out fertilizers) Varieties (Vero, Rosa and Rosanna) and (Gitan, Monterosa) Monogerm (Mon.) and multi germ (Mul.) respectively, in a Secondary plots.

Table (1): Physical and chemical properties of soils L1 , L2 Location under study

Properties	Soil L1		Soil L2	
	Depth Cm		Depth Cm	
	0-15	15-30	15 -30	0-15
Texture	SL	SL	CL	CL
Available N (PPm)	50.4	65.2	55.5	70.3
Available K (PPm)	85.6	120.4	71.5	96.6
Available P (PPm)	2.5	2.6	3.5	4.7
Organic M. %	0.63	0.97	0.14	0.47
$CaCo_3$ Total %	22.8	28.4	15.7	22.6
Ec dS m / m	2.7	3.4	2.4	2.6
P^H 1:1	8.0	8.2	8.1	7.8

Sowing date L1 and L2 (9, 12. April) respectively, the seeds was sowing by a developmental seed sowing model 2001 after plowings and leveling the field Seeds were sowing in a same depth at 2.5 Cm, the line long about 50 Meters and the Distance between lines are 30 Cm , between plants about 12 Cm the field irrigated by sprinkler irrigation , Phosphate fertilizer levels (PFL) added at the sowing with The first part of the Nitrogen fertilizer as Urea 140 Kg/ha , weeds control by the

Pyramine , the roots harvested in the (28 Sept). and (4 0ct.) for the two location respectively, (DWR) the weight of air dry roots /plant) and (DWL) Weigh of air dry vegetative parts / plant were taken at harvest , oven dry weight for roots (ODWR) and oven dry weight for leaves (ODWL) had been taken. Samples were sent to Mosul sugar company to measure and determine the quality of roots (Total Soluble Salt (TSS), Sugar percent (SP) and (PP) .purity percent) then the all plots harvested for each treatment to obtain the Total roots yield (TY) as Ton/ha, The experiment analysis by Duncan probability 0.05 to identified a significant (Sig) treatment.

RESULTS AND DISSCUTION

Sugar beet quantity ,Table (2) showed the (DWR) (Kg / plant) are increase significantly with the phosphate fertilizer(PFL) increase in two locations (L1, L2) under study. increment percentage(IP) as compared to the first level of adding phosphate are (34.3, 85.5%)and (14 , 61,9%) for (L1 ,L 2) respectively. the reasons of these results related to the effect of P in biotic process in plant like cell division and active transport carbohydrate material from leaves as source to the root as a sink (Krauss 2003 ,and Draycott 2006).

Phosphorus compounds are involved in the transfer and storage of energy within plants ,for these purposes the (PFL) increase the DWR/plant. these results showed the L1 is more response to adding fertilizer than L2 because the available P in the first Location lower than L 2 table (1) also most soil properties for L1 location is better than L2 location like available nitrogen and low electric conductivity with suitable soil texture for sugar beet. these results agreed with (.Lamb *et al* 2001) they suggested to add phosphorous fertilizer (100 – 12.5)kg P_2O5/ ha , when the soil test by Olsen Method between (3 - !5) ppm respectively.
The results corresponded with albadrani 2006 she found ,the weight of root /plant between(1.12 to 1.35) kg /root in two locations in Iraq Vero variety gave highest weight of roots / plant at the two locations, so this variety can be considered because having high genetically properties .and suitable for Iraqi conditions . the highest weights of roots were obtained from the interaction between the third level of phosphate with Vero Variety are (2.14and 2.36) kg / plant fore L1 and L 2 respectively. Table (3,) showed the (PFL) increase significantly the (ODWR) in two locations when we compared to the first level, the (IP) were (6.9, ,41.8%), and (6.5 , 41.3 %) for the (L1 ,L2) respectively the reasons to get these results because (PFL) affect the air dry weight roots / plant and these reflected to the oven dry more over, Plants need phosphorus for growth, utilization of sugar and starch, photosynthesis, nucleus formation and cell division, fat and albumen formation (Roy etal 2006). Results declare No significant difference between the Varieties (Vero , Rosa and Rosanna) which are a Mongerm varieties these can be suitable and adapted for these locations under studied, Results concerned with many researches that (Mon) having a good growing properties. Alrashidi 2003, and Abdal 2005. Fig (1) showed the air dry weights of vegetative part of plant (D WL) of the two locations, phosphate increase significantly as the fertilizer increase which these results agreement with the weight of the roots / plant, the (IP) are (9.6,14.9%) and (11.9, 16.4%) when compared to the first level of phosphate fertilizer for the two locations respectively. The reasons of these results depend on P increasing the biotic processes in plant and its up take of nutrients to increase Mobil nutrients in plant which improve (LAI) and increase the light absorbance by leaves which reflect on

photosynthesis's processes, Results showed the impotents of the leaves which consider a factory of the sugar production for sugar beet, and then storage in the root (Draycott 2003.While the effect of varieties on Air dry weights (DWR), the figs showed there was no significant difference between most varieties in the two location especially on the Mongerm in spite of the L2 gave a high weight than L1, the interaction between P levels and Varieties were from P3 with Vero (0.9 and 0.69) kg /plant fore L1 ,L2 respectively.

Table (2): Effects of phosphate fertilizer (PF) and varieties (VR) on Weight of Root /plant (DWR) on two locations L1, L2 respectively

	varieties	phosphate fertilizer Kg P/ ha			Effect of varieties
		60	90	120	
L1	Vero	0.94	1.43	2.14	1.5 a
	Rosa	0.86	0.94	1.23	1.01 c
	Rosanna	0.98	1.3	1.67	1.32 b
	Gitan	0.66	0.94	1.36	0.98 c
	Montrose	0.69	0.88	1.3	0.98 c
		0.83 c	1.09 b	1.54 a	
L2	Vero	1.22	1.62	2.36	1.73 a
	Rosa	1.21	0.98	1.46	1.22 c
	Rosanna	1.2	1.42	1.84	1.43 b
	Gitan	0.87	0.98	1.42	1.04 d
	Montrose	0.73	0.92	1.6	1.08 d
	Effect of Fertilizer	1.03 c	1.18 b	1.74 a	

Table(3) :Effects of phosphate fertilizer (PF) and varieties (VR) on oven dry Weight of root (ODWR) Kg /plant on two Regions L1 , L2 respectively

	varieties	Phosphate fertilizer Kg P/ ha			Effect of varieties
		60	90	120	
L1	Vero	0.41	0.52	0.64	0.52 a
	Rosa	0.38	0.49	0.66	0.51 a
	Rosanna	0.28	0.48	0.61	0.46 a
	Gitan	0.26	0.39	0.57	0.41 a
	Montrose	0.24	0.38	0.56	0.37 b
		0.34 c	0.46 b	0.61 a	
L2	Vero	0.57	0.57	0.69	0.61 a
	Rosa	0.51	0.57	0.59	0.56 a
	Rosanna	0.46	0.54	0.69	0.56 a
	Gitan	0.42	0.51	0.68	0.53 a
	Montrose	0.32	0.42	0.62	0.45 b
	Effect of Fertilizer	0.46 b	0.48 b	0.65 a	

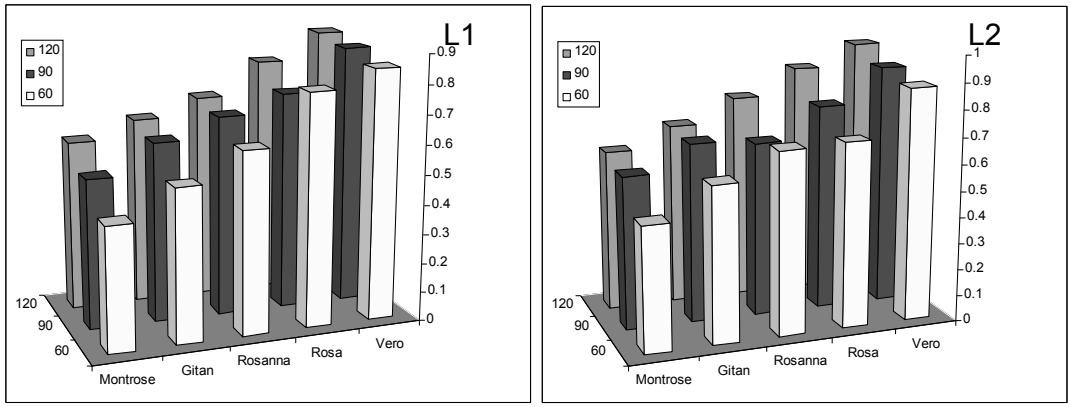
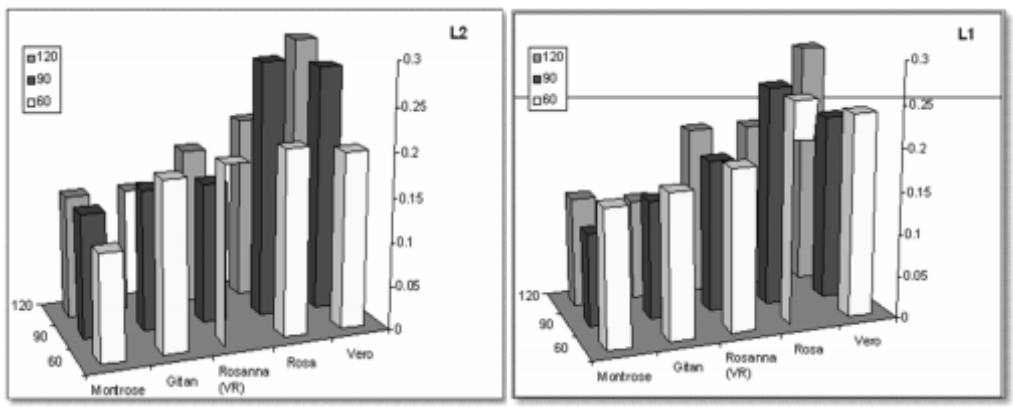


Fig (1) : Effects of phosphate fertilizer (PF) and varieties (VR) on Air dry Weight of leaves (DWL) Kg /plant on two Regions L1 ,L2 respectively

Results showed in (Fig 2) L1 and L2 there were no significant difference between P2 and P3 in (ODWL) / plant, there were no differentiated between the (Mon) Vero and Rosa in this property of leaves, interaction to get a high yield of (ODWL) However the Vero with P3 (0.29 and 0.3) Kg/plant for L1 and L2 respectively .Table. (4) Showed (PFL) gave a high significant effect on the total yield To/ha (TY) as the fertilizer increase the (IP) as compared to the first level 60 Kg/ha (6.5%, 10.6%) and (0.8%, 0.7%) for the two locations respectively these results related to increase the (DWR) as a result of increase (LAI), Leaf Area Index these consistent with the results (alrashidi 2001 and, (Lamb *et al* 2001) and Albadrani 2006) that (TY) reaches (82- 90) ton / ha with good managements and suitable soil fore sugar beet , As consistent with the previous results in L1 and L2 the Mon. (Vero ,Rosa ,and ,Rosanna) also gave a high significant results compared to the others varieties used in these experiments . the interactions between these treatments in the (TY) of roots Ton /ha are from the P3 with the Vero (86.2 and 88.92) Ton / ha roots for L1 and L2 respectively.



Figs (2) : Effects of phosphate fertilizer (PF) and varieties (VR) on Weight of oven dry leaves (ODWL) Kg /plant on two Regions L1 ,L2 respectively

So from these results of (TY)Ton /ha conclude firstly (Sugar beet not growing without fertilizer to reach an economic yield in these two locations under Iraqi conditions, second Vero variety gave a high significant results with the two

locations under study And confirmed this variety a suitable for sugar beet growing on these locatins under studied. How ever sugar beet require a high level of management and grown on more productive soils (Sims and Smith 2002), other wise the soil types and constituents (organic matter ,clay content ,percent of lime) these have a decided effect on the availability of phosphorous that effectuated sugar beet yield , (Brosba et al 2002)

Sugarbeet Quality Figs (3) and Tables (5,6,7) showed some measurements on quality of the roots for sugar beet (total soluble salt (TSS) with a sugar percent (SP) and purity percent (PP) more over we measure white sugar (WS) after sending roots sample to Mosul sugar beet company , from these Figs (5 and 6) the (PFL) increase the (TSS) but not in significant affect ,also there were some difference between varieties but not reach a Sig. for the two locations L1 and L2, the interaction between the treatment (Rosa and Vero) with P 3 in these L1 and L 2 (20.4% and 20.2%) respectively.

Table(4) :Effects of phosphate fertilizer (PF) and varieties(VR) on total yield of root (TY) Ton/ha on two Regions L1 ,L2 respectively

	varieties	Phosphate fertilizer Kg P/ha			Effect of varieties
		60	90	120	
L1	Vero	78.69	84.69	88.92	84.1 a
	Rosa	77.63	79.22	86.43	81.09 a
	Rosanna	75.3	78.85	83.76	79.18 b
	Gitan	78.1	78.31	80.33	77.91 b
	Montrose	76.83	78.63	74.69	76.71 c
		77.38 b	76.71 b	82.82 a	

	varieties	Phosphate fertilizer Kg P/ ha			Effect of varieties
		60	90	120	
L2	Vero	76.4	80.22	86.2	80.94 a
	Rosa	74.12	76.16	79.98	77.42 b
	Rosanna	72.1	74.72	77.41	77.74 b
	Gitan	68.43	72.84	76.72	72.66 c
	Montrose	66.41	74.2	72.69	71.1 c
	Effect of Fertilizer	71.4 c	76.03 b	79 a	

We know about (TSS), should attached with the sugar percent to be desirable in production of sugar beet (alrashidi 2001, albadrani 2006), Tables (8 and 9) showed sugar percent (SP) which is the most important property of the roots of sugar beet increase with the (PFL) increase in two locations, the (IP) are (4.8% , 11.2%), (-10.9%, 17.1 %) for their locations receptively, when compared with first level of fertilizer, from these results showed L2 is more responded than L1 in (SP) the most important factor which affect the (SP) are temperatures at night during the mature of plant before 30 days of harvesting (Draycott 1996) These results were consistent with the finding obtained by), Marvon (1997) and Al -

Rashidi (2001) they found the percentage of sugar in root reach about 17% which increase significantly with (PFL) (jaggad 2008).

Results indicated the Vero varieties was to surpass the all varieties growing in the two locations under study, the interaction to get highest percentage from Vero with P 3 are (16,0 % and 16.4 %) respectively.

Tables (10 and 11) showed (PF L) increase the purity percentage of the roots (PP) significantly as the fertilizer increase , the (IP) were (14 .4 %,22.4 %) and (11.1%,20.4%).for these locations respectively as compared to the first level of the phosphate fertilizer 60Kg/Pha. Results are agreed with the results obtained by (Ibrahim *et al* 2005, Albadrani 2006) they found also the Vero varieties to surpass the all varieties growing in the their studied, which certainly attributed to their genetically properties for growing in these locations.

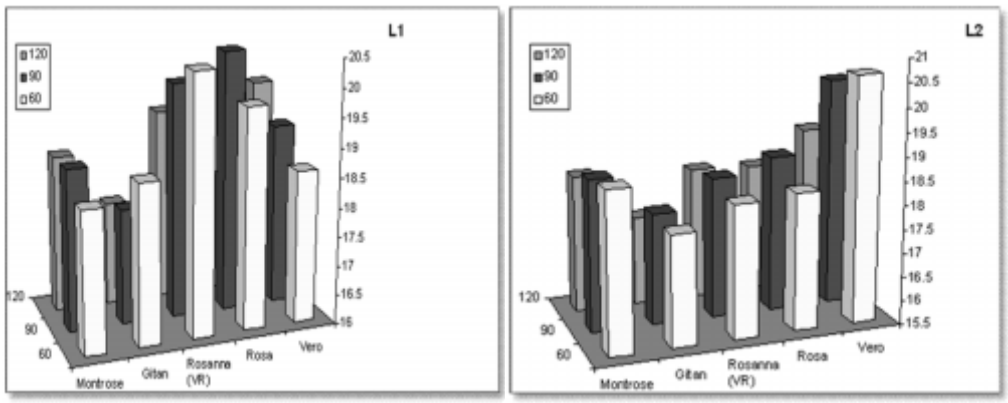


Fig (3): Effects of phosphate fertilizer (PF) and varieties (V) on percent of total soluble salt (TSS %) on two Regions L1 ,L2 respectively.

The interaction for (PP %) were between (VR) and (PFL) , found Vero and P3 in L2 and Rosa with P3 In L1 (86 .4 % and 87 .7 %) Respectively .Tables (12 and 13) showed white sugar (WS) affect significantly by (PFL) especially when compared to first level in L1 and L2 treatments. The (I P) Were (5.3 %, 10.9 %) and (5.4 %, 12.5 %) for P2 and P3 Respectively.

In general (PFL) application increase (SP) and (PP) with corresponding to increase (DWR) and (WS) from these results we found 90 kg P/ha was optimum rate to obtain higher yields and better quality of sugar beet in two locations under studied with Iraqi conditions). Vero variety is significantly increase most of properties in yield and Qualities for Sugar beet as compared to the other varieties under study at the two locations (Ibrahim et al 2005) they found varieties differ in yields and quality .these results agreed with Smith and Smith (1997) they showed weights of white sugar related with phosphate fertilizers .and with Saccomani and Stevanato (2007) they found(Mon) seed gave a high results in white sugar than the (Mult) seeds theses results clearly showed positive effect of P fertilizer application increase leaves areas and root weight of the crop which reflect on beet yield for sugar content and sugar yield on theses locations under Iraqi environments .

Table (5) : Effects of phosphate fertilizer(PFL) and varieties(VR) on sugar percent (SP) on two Regions L1 ,L2 respectively

	varieties	Phosphate fertilizer Kg P/ ha			Effect of varieties
		60	90	120	
L1	Vero	14.3	15.6	16.0	15 .3 a
	Rosa	12.9	14.6	15. 7	14 .4 a
	Rosanna	12.7	14.1	14.8	13 .8 b
	Gitan	11.5	13.1	14.6	13 .1 b
	Montrose	11.1	12.7	13.4	12 . 4 c
		12.5 b	13.1 a	13.9 a	
L2	Vero	14.9	15.6	16.4	15.6 a
	Rosa	13.1	14.8	15.6	14.5 b
	Rosanna	12.9	14.7	.15.0	14.2 b
	Gitan	11.9	13.6	14.6	13.4 c
	Montrose	11.5	12.8	13.6	12 .6 c
	Effect of Fertilizer	12 . 9 c	14 .3 b	15 .1 a	

Table (6) :Effects of phosphate fertilizer (PFL) and varieties (VR) on purity percent (PP) on two Regions L1 ,L2 respectively.

	varieties	Phosphate fertilizer Kg /ha			Effect of varieties
		60	90	120	
L1	Vero	76.8	81.5	81.2	79.8 a
	Rosa	65.2	71.2	87.1	74.5 b
	Rosanna	62.1	70.4	76.6	69.7 c
	Gitan	61.3	72.8	82.1	72.1 b
	Montrose	60.3	76.6	71.6	69.5 c
		65.1 c	74.5 b	79.7 a	
L2	Vero	72.1	76.8	86.4	78.4 a
	Rosa	71.2	78.7	85.4	78.4 a
	Rosanna	70.6	79.6	81.9	77.4 a
	Gitan	66.7	76.2	83.9	75.6 a
	Montrose	61.1`	68.4	73.9	67.8 b
	Effect of Fertilizer	68.3 c	75.9 b	82.3 a	

Table (7) : Effects of phosphate fertilizer (PFL) and varieties (VR) on white sugar (WS) on two Ton/ha Regions L2 ,L1 respectively.

	varieties	Phosphate fertilizer Kg P/ha			Effect of varieties
		60	90	120	
L1	Vero	1.434	1.572	1.623	1.543 a
	Rosa	1.321	1.342	1.463	1.375 b
	Rosanna	0.689	0.884	0.962	0.912 c
	Gitan	0.541	0.582	0.599	0.574 d
	Montrose	0.432	0.469	0.453	0.451 e
	Effect of Fertilizer	0.919 c	0.968 b	1.02 a	
L2	Vero	1.36	1.335	1.423	1.328 b
	Rosa	1.23	0.642	0.653	1.318 b
	Rosanna	0.662	0.539	0.614	0.558 c
	Gitan	0.521	0.536	0.611	0.526 c
	Montrose	0.432	0.908 b	0.969 a	
	Effect Of Fertilizer	0,861 c	0,908 b	0.969 a	

تاثيرالتسميد الفوسفاتي وخمسة اصناف من البنجر السكري(*Beta Vulgaris L .*) في الحاصل والنوعيه

صالح محمد الراشدي
قسم علوم التربه والمياه –كلية الزراعه والغلبات - جامعة الموصل / العراق

الخلاصة

نفذت تجربتين حقليتين في موقعي لزراعة البنجر السكري لبيان تاثير ثلاثة مستوياتمن السماد الفوسفاتي (٦٠ – ٨٠ – ١٢٠)فسفور لكل هكتار على شكل سوبر فوسفات الكالسيوم ٤٥% خامس اوكسيد الفسفور مع خمسة اصناف من البذور المستوردة حديثا ، احادي الجنين (Vero, Rosana, Rosa) وعقدد الاجنه (Gitan, Monterosa) لشارت النتائج ان المحصول الكلي للجذورطن/هكتار ازداد بصوره معنويه مع زيادة مستويات السماد المضاف وفي كلا الموقعين وكانت نسبة الزيادة (٢٠.٣ %، ٢٤.٦ %) مقارنة بالمستوى الاول من الاضافة ولكلا الموقعين وعلى التوالي ، كذلك فان نسبة السكر في الجذور انخفضت مع زيادة مستويات االسماد المضاف وبلغت نسبة الزيادة (٠.٦٥ % ، ٠.٨٩ %) وعلى التوالي لكلا موقعي الدراسة. وبينت النتائج ان الاصناف الاحادية تفوقت معنويا في في الحاصل الكلي للجذور وكذلك في نسبة السكر في الجذور مقارنة بالاصنلف المتعددة الاجنه ، ومن هذة النتائج التي اكدت على ضرورة استخدام التسميد الفوسفاتي مع الاصناف الاحادية الجنين للوصول الى الحاصل الاعلى والنوعية الافضل لمحصول البنجر السكري وفي كلا موقعي الدراسة وتحت الظروف العراقية .

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