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EFFECT OF IRRIGATION, POTASSIUM APPLICATION AND DISTANCE, FROM DRAIN LINE ON TUBER YIELD OF POTATOES (*Solanum tuberosum* L.) CROP IN MIDDLE DELTA

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ABSTRACT

Two field experiments were carried out at Kafer El-Zayat,. El-Gharbia Governorate, Middle Delta and allocated at 30-50' N Latitude, 30-49'E Longitude . during the two successive seasons of 2009/2010 and 2010/2011. The field is provided by tile drain network spaced at 20 m. with 1.2 m. depth, in order to study the effect of distances from drain line, potassium application and irrigation scheduling on yield of potatoes. Experiments were conducted in a split- split- plot design. The study was concerned with the use of different rates of potassium fertilization (0, 72, 96 and 120 kg K_2 O/fed.) under different irrigation scheduling (40, 60 and 80 % of available water)

Results showed that:

Decreasing distance from drain line L/2 to L/4 to L/8 gave significant increase in potatoes yield. The study concerned the use of different rates of potassium fertilization (0,72,96 and 120 kg K_2O/fed.), under different irrigation scheduling (40, 60 and 80 % of available water)on potatoes crop in clay soil. Generally, in most cases, the treatment of the medium and highest soil moisture level (60 and 80 % of available water) gave the highest significant values, potatoes tuber, as well as, consumptive use. While the lowest one were recorded when the lowest soil moisture level (40% of available water) was applied.. Generally, all k rates gave the highest significant values for all parameters under study. The second level of potassium 96 kg K_2O / fed. achieved the highest significant values of tuber yield,. Whereas, the high values of water productivity and consumptive use were obtained when 120 kg K_2O/fed. and 40% available water were applied. In most cases, were high levels of potassium under 80 % of available water gave the highest significant values for all parameters under study in both seasons.

Keywords: Drain line **,** potatoes, yield, irrigation scheduling and water productivity.

INTRODUCTION

Production of potatoes (*Solanum tuberosum* L.) takes a very important place in world agriculture, with production potential of about 327 million tons harvested and 18.6 million ha planted area (FAO, 2004).Potatoes are considered one of the most important vegetable crops grown in Egypt, as well as, in the whole world. It occupies a great figure in local consumption and export. The performance of any crop depends not only on its genetic characteristics but also on the surrounding environmental conditions, particularly, methods of irrigation and water supply. Therefore, growers have to adopt modern techniques of cultivation. Potatoes is one of the world's major food crops where the dry matter production/ha is more than other major cereal crops (Burton, 1984). Developing countries produce 93 million tons representing one-third of the world's production (FAO, 1988). The consumer's requirements for fresh potatoes are often associated with aesthetic and internal qualities including the appearance of the tubers, freedom from defects and contaminants.

Fertilization especially potassium, is considered one of the most important factors affecting the growth and yield of potatoes. Potassium has two roles in the functioning of plant cells. First, it has an irreplaceable part to play in the activation of enzymes which are fundamental to metabolic processes, especially the production of proteins and sugars. Only small amounts of potassium are required for this biochemical function. Second, potassium is the “plant-preferred” ion for maintaining the water content and hence the turgidity (rigidity) of plant cells.. Because of its very importance in turgid maintenance, potassium is essential to obtain maximum leaf extension and stem elongation.

Many researchers recorded an increase of potatoes tubers yield as a result of increasing the levels of potassium (K) fertilization El-Gamal (1985) and Humadi (1986) Such increases in yield of potatoes tubers was either due to the formation of large size tubers or increasing of the number of tubers per plant or both. Potassium also plays a key role in increasing crop yield and improving the quality of produce Tisdale *et al* (1985).

Few studies on irrigation water requirements of potatoes crop, especially in the newly reclaimed soils, were conducted in Egypt. Increasing number of irrigations, levels of field capacity, irrigation amounts, pan evaporation ratios and/or potential evapotranspiration (ETo) up to the maximum level increased growth parameters; i.e. leaf area, total plant dry matter (Fatthallah and Gawish, (1997).Irrigation frequency is one of the most important factors in trickle irrigation scheduling. Due to the differences in soil moisture and wetting pattern, crop yields may be different when the same quantity of water.). High frequency irrigation enhanced potato tuber growth and water use efficiency.

The aim of the present work was study the effect of the distance from drain line, irrigation regime and potassium application on growth of potato yield.

MATERIALS AND METHODS

A field trial was conducted during the two successive growing seasons 2009/2010 and 2010/2011 at Ebiar village in Kafr EL-Zayat, El-Gharbia Governorate, Middle Delta. The site represents the circumstances and conditions of Middle Nile Delta region and allocated at 30-50' N Latitude, 30-49'E Longitude .Potatoes tubers of Diamante variety were planted on Dec.7, 2009, as winter plantation (Season 2009/2010), and on Dec. 10,2010 as (season 2010/2011). Harvesting was generally carried out after 115 days from planting . Seed tubers were dipped in a solution of Rhizolex (1 g) dissolved in 1 liter of water for 5 minutes and dried in shade before planting, which prevents the decay of seed tubers. The soil texture of this experimental site is clayey, the rain fall of the region were 100 and 140 mm in the first and second seasons respectively.

Table (1): Mean of some meteorological data for Kafr EL-Zayat area during the two growing seasons of potatoes crop

	Season 2009/2010							Season 2010/2011						
	Air Temp.C°		Relative humidity,%		wind speed, km/day	Ep,mm/day	rain, mm/month	Air Temp. C°		Relative humidity, %		wind speed, km/day	Ep,mm/day	rain, mm/month
	maxi.	min.	max	min				max	min	max	min			
Nov.	26.0	10.5	77.7	50.0	58	2.7	----	26.8	11.0	82.0	54.2	63	2.8	------
Dec.	22.2	8.8	76.5	52.0	64.0	2.1	58	22.0	8.3	85.0	55.7	58.3	1.8	90.0
Jan.	21.5	7.8	83.5	55.0	53.0	1.8	----	20.3	5.8	84.2	54.0	42.5	1.9	-------
Feb.	24.5	9.4	84.2	55.7	76.8	2.9	32	23.4	7.4	87.0	54.0	64.0	2.9	22.5
Mar-	24.3	10.0	76.3	44.0	110	4.3	10	21.8	6.8	86.3	49.5	77.4	3.4	14.0
Apr-	28.2	11.0	96.0	40.7	96	5.6	-----	26.5	10.0	85.0	47.7	83.7	4.9	----
May-	29.6	14.4	72.6	39.5	96	6.9	-----	29.0	13.0	76.7	38.0	102.0	5.9	-----

*** Source: meteorological station at Sakha 31-07' N Latitude, 30-57'E Longitude, N.elevation 6 m.**

The experiments were conducted in a split -split –plot design with three replicates .The main plots were distances from drain line, the sub- plots were potassium application and the sub -sub- plots were Irrigation treatments as follow:

Main plots (distances from drain line):

L/2:Distances of 1/2 from drain line ,L/4:Distances of 1/4 from drain line, and L/8:Distances of 1/8 from drain line

sub- plots (potassium application):

a- 80% of available water (I_1),b- 60% of available water (I_2).

c- 40% of available water (I_3).

sub -sub- plots (irrigation)

K fertilizer in the form of potassium sulphate (48% K_2 O) were four levels i.e., K_0(0), K_1(72), K_2(96) and K_3(120) kg K_2O /fed., respectively. The fertilizer was applied before cultivation.

Table (2): Mean values of some soil Physical chemical properties and some water constants of the experimental site before cultivation in the two growing seasons

Soil depth (cm)	Particle size distribution%			Texture class	F.C %	P.W.P %	Available Water%	Bulk density Mgm^{-3}	EC dsm^{-1}	pH	Soluble cations $MeqL^{-1}$				Soluble anions $MeqL^{-1}$			
	Sand	Silt	Clay								Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Co^{2-}_3	Hco^{-}_3	Cl^{-}	So^{2-}_4
0-15	26.0	28.0	46.0	Clay	47.0	25.3	21.7	1.19	1.5	8.15	0.30	0.10	0.76	0.02	-	0.55	0.21	0.42
15-30	29.0	23.0	48.0	Clay	39.0	21.8	17.2	1.16	1.57	8.00	0.31	0.10	0.79	0.02	-	0.57	0.22	0.43
30-45	26.5	26.0	47.5	Clay	38.0	21.9	16.1	1.30	1.65	8.00	0.34	0.10	0.89	0.02	-	0.65	0.23	0.47
45-60	27.5	25.5	47.0	Clay	38.5	20.8	17.7	1.20	2.78	7.90	0.84	0.27	1.25	0.03	-	0.45	0.23	1.71

Data collection:

Irrigation water applied (Wa):

Submerged flow orifice with fixed dimensions was used to convey and measure the irrigation water applied, according to the following equation (Michael, 1978).

$$Q = CA \sqrt{2gh}$$

Where:

Q = Discharge through orifice, (cm^3 sec^{-1}).

C = Coefficient of discharges (0. 61).

A = Cross sectional area of orifice, cm^2.

g = Acceleration due to gravity, cm/sec^2 (980cm/sec).

H = Pressure head, over the orifice center, cm.

Total number of irrigation were events 10, 7 and 5 for treatment I_1, I_2 and I_3, respectively including sowing irrigation.

consumptive use (CU):

Water consumptive use was calculated using the following equation (Hansen *et al.,* 1979).

$$Cu = \sum_{i=1}^{1=4} D_1 \times D_{b1} \times \frac{PW_2 - PW_1}{100}$$

CU = Water consumptive use (cm) in the effective root zone (60 cm).

D_1 = Soil layer depth (15 cm each).

D_{b1} = Soil bulk density, (Mgm^{-3}) for the given depth.

PW_1 = Soil moisture percentage before irrigation (on mass basis, %).

PW_1 = Soil moisture percentage, 48 hours after irrigation (on mass basis, %).

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I = Number of soil layers each (15 cm) depth.

Water productivity (WP):

It was calculated according to (Ali *et al.,* 2007).

$WP = GY/C_u$.

Where WP (kg/m^3), GY is grain yield (kg/fed).

and C_u total water consumption of the growing season (m^3/fed.)

Productivity of irrigation water (PIW)

was calculated as (Ali *et al.,* 2007)

$$PIW = GY/I$$

Where I is irrigation water applied (m^3/fed.).

The obtained data were statistically analyzed according to Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

Water applied:

Water applied (WA) to tuber potatoes consists of two items. These are (1) irrigation water (IW) and (2) rainfall (RF), as shown in Table (2). Amount of irrigation water (IW) for I_3 treatment is the lowest, and the amount for I_1 treatment was the highest. Total values of applied for I_1, I_2 and I_3 treatments were 2567, 2101, 1787 m3 / fed. and 2798, 2488 , 1938 m3/fed for first and second season respectively. Water applied in the second season more than the first season caused by the difference between the rainfall in these two seasons. Sowing irrigation was the same for all irrigation treatments. The effective rainfalls were 420 m^3 and 588 m^3 over both growing seasons. It is obvious that amount of irrigation water applied was gradually increased as a result of growing up of a vegetative growth that required higher amounts of irrigation water to meet its water requirements, then it decreased again. These findings may be attributed to growth stages, and the availability of soil water content in the root zone.

Table (3): Number and irrigation intervals as affected by irrigation treatments during the two growing seasons

Treatments	Season 2009/2010											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Rain fall	Total
I_1(80% of AW)	437	170	180	200	220	240	210	190	180	120	420	2567
I_2 (60% ofAW)	437	200	230	260	200	200	154				420	2101
I_3 (40% of W)	437	200	200	280	250						420	1787
	Season 2010/2011											
I_1(80% of AW)	480	180	190	200	210	230	220	200	170	130	588	2798
I_2 (60% ofAW)	480	200	220	310	270	220	200				588	2488
I_3 (40% of W)	480	190	200	200	280						588	1938

Consumptive use (Cu):

Tabulated data in Table (7) revealed that (Cu) increased as the irrigation application increased. potatoes plants of irrigation treatment I_1 has the highest value of water consumption followed by potatoes plants in the treatments (I_2) and (I_3), respectively. Mean values of seasonal water consumptive use were 2120.0, 1980.0 and 1200.9 m^3 /season, for the treatments of 80, , 60 and 40 % of available water respectively . The most probably explanation for these results is that more available soil moisture was resulted from more irrigation times, giving chance for luxury consumption of water, which ultimately resulted in enhancing transpiration from potatoes plants, in addition to high water evaporation from the soil. obtained data in table (6) revealed that the treatment of 120 K_2 O kg/fed. with 80 % of available water gave a highly significant in consumptive use in both seasons. The lowest value was obtained with control (without addition of K fertilizers) under 40 % of available water .

Effect of distances from drain line on potatoes tuber yield :

Data in table (5) showed that decreasing distance from drain line L/2 to L/4 to L/8 resulted in significant increase of the potatoes tuber yield (ton/fed). Values of potatoes tuber yield near the drain were 12.412, 11.777 and 11.253 for L/8, L/4 and L/2 respectively as a mean values for first and second seasons . This was due to the effect of drainage on conditioning water-air relationship in the root zone, and its effect on mobility of nutrients to the plant roots, which caused more vegetative growth and subsequently produced, higher yield. These results are in agreement with those obtained by Ramadan *et al* (2oo6) and Gendy et al (2009).

Effect of irrigation regime on potatoes tuber yield :

Data in Table (4) showed that total yield /fed significantly decreased as water stress was increased .The highest potato yield was obtained by irrigation with 80% of available water (16550 kg / fed) as mean of the two seasons. It is obvious that frequent irrigation (short time between irrigations) produced maximum values of total yield of potato at the two studied seasons. On the contrary, minimum of total yield was 7.500 ton/fed in the two studied seasons were obtained when potatoes irrigation was at 40% of available soil moisture.. It can be terminated that, total yield of tubers increased with increasing irrigation frequency (irrigation at 80% available soil moisture). These results are similar to those findings by Balanger *et al*. (2000)and Youssef et al (2007)**.** As a general view, data of interacted factors under such investigation illustrated in Table (4) indicated that all treatments of K levels with 80 % of available water gave the highest significant value of tuber yield, while, the lowest value was obtained when the control treatment (without addition of K fertilizers) or/and K_1 under 40 % of available water was practiced in both seasons.

Table (4): Effect of distances from drain line,potassium application and irrigation treatment on tuber potatoes yield (ton/fed), in combined analysis of the two growing seasons.

		I_1 (40% of AW)	I_2 (60% of AW)	I_3 (80% of AW)	K mean
L/8	K_0	8.727 c	9.183 c	9.400 d	9.103
	K_{72}	11.310 b	12.820 b	13.693 c	12.608
	K_{96}	12.617 a	13.397 a	15.100 b	13.704
	K_{120}	12.967 a	13.180 ab	16.550 a	14.232
L/4	K_0	8.127 c	9.043 c	9.157 c	8.776
	K_{72}	10.700 b	12.167 b	12.487 b	11.784
	K_{96}	12.093 a	12.760 a	14.823 a	13.226
	K_{120}	12.167 a	12.700 a	15.100 a	13.322
L/2	K_0	7.500 c	8.933 c	9.000 c	8.478
	K_{72}	10.053 b	11.920 b	12.000 b	11.324
	K_{96}	11.267 a	12.100 b	13.833 a	12.400
	K_{120}	11.600 a	12.800 a	14.027 a	12.809
I Mean		10.760	11.750	12.913	11.814

In column under each L, means followed by a common letter are not significantly different at the 5 % level by DMRT.

Comparison	S.E.D	LSD (5%)	LSD (1%)
2- I means at each L*K	0.191	0.385	0.513
2- k means at each L* I	0.184	0.375	0.504

Interaction between distance from drain line and irrigation regime on tuber yield:

Data in table (5) show that, tuber yield was significantly decreased with increasing the distance from drain line in both studied season

Available data in Table (5) reveal obviously that the yield of tuber were affected significantly by irrigation treatments, the treatment of 80 % of available water gave a highest significant values, while, the lowest one were obtained when 40 % of available water was applied in both seasons.

Table (5): Interaction between distance from drain line and irrigation treatment on tuber potatoes yield ton/fed

	L/8	L/4	L/2	Mean
40% of AW	11.405	10.772	10.105	**10.761**
60% of AW	12.145	11.668	11.438	**11.750**
80% of AW	13.686	12.892	12.215	**12.931**
Mean	**12.412**	**11.777**	**11.253**	**11.814**

Effect of K-fertilization on potatoes tuber:

Examining the effect of potassium levels on potatoes yield tuber ton/fed., the highest significant values were obtained when plants treated with 120 K_2O kg/fed. as compared to other treatments of K fertilizers, while, the lowest one were recorded with control (without addition of K fertilizers) in both seasons. These results are similar to those found by Balanger *et al*. (2000)and Youssef et al (2007)**.**

Interaction between K-fertilization and irrigation regime on tuber yield:

Data presented in Table (6) showed that treatments of 80 % of available water gave the highest significant values of potatoes yield tuber kg/fed., while, the lowest value was recorded with the treatment of 40 % of available water in both seasons. Bosnjak *et al* (1997) found that tubers yield were highest in the 75-80% available water. This was equivalent to a water requirement of 460 - 480 mm / season. Ghosh *et al* (2000)found that tuber yield decreased with decreasing soil moisture with the greatest reduction at 45% AW.

With respect to the interacted factors under the current study, data tabulated in Table (6) revealed that high level of K fertilizer (120 K_2 O kg/fed.) gave the highest significant values of potato yield tuber ton/fed. under 80 % of available water, whereas, the lowest value was recorded with control (without addition of K fertilizers) with 40 % of available water in both seasons. Alternatively, K_3 and K_2 had similar effect on potato yield tuber (ton/fed.) under 80 % of available water in 2nd season only.

Table (6): Interaction between K-fertilization and irrigation regime on tuber yield (ton/fed.):

	40% of AW	60% of AW	80% of AW	Mean
K_1(0 k_2o)	8.118	9.053	9.186	8.478
K_2(72 k_2o)	10.688	12.302	12.727	11.324
K_3(96 k_2o)	11.992	12.752	14.586	12.400
K_4(120 k_2o)	12.244	12.893	15.226	12.809
Mean	10.761	11.750	12.931	11.814

Water productivity (WP):

Data in table (7) showed that In most cases, that water productivity was affected significantly when potassium was added by any rates with any soil moisture levels in the current study as compared to control (without addition of K fertilizers) in the first season. In 2nd one the K_2 and K_3 with 80 % of available water had a similar significant effects, while, the lowest yield was recorded when control (without addition of K fertilizers) under 80 % of available water was added. On the other hand, water productivity wasn't affected significantly by irrigation treatments in both seasons. Similar results were recorded by; Ali (1993)

Table (7): Potatoes yield (kg/fed), consumptive use (m^3),Water applied (m^3), Water productivity Kg/m (WP) and Productivity of irrigation water Kg/m^3 (PIW) in the combined analysis over both seasons.

Distance from drain	Potassium applied	Irrigation treatment	Yield kg/fed.	C_u (m^3/fed)	Wa (m^3/fed)	WP (kg/m^3)	PIW (kg/m^3)
L/2	K_0	80% AW	9000	2120.0	2682.5	4.245	3.355
		60%AW	8933	1980.0	2294.5	4.512	3.893
		40%AW	7500	1200.9	1862.5	6.245	4.026
	K_{72}	80% AW	12000	2120.0	2682.5	5.660	4.473
		60%AW	11920	1980.0	2294.5	6.020	5.195
		40%AW	10053	1200.9	1862.5	8.371	5.397
	K_{96}	80% AW	13833	2120.0	2682.5	6.525	5.156
		60%AW	12100	1980.0	2294.5	6.111	5.273
		40%AW	11267	1200.9	1862.5	9.382	6.049
	K_{120}	80% AW	14027	2120.0	2682.5	6.617	5.229
		60%AW	12800	1980.0	2294.5	6.465	5.578
		40%AW	11600	1200.9	1862.5	9.659	6.228
L/4	K_0	80% AW	9157	2120.0	2682.5	4.319	3.413
		60%AW	9043	1980.0	2294.5	4.567	3.941
		40%AW	8127	1200.9	1862.5	6.767	4.363
	K_{72}	80% AW	12487	2120.0	2682.5	5.890	4.654
		60%AW	12167	1980.0	2294.5	6.145	5.302
		40%AW	10700	1200.9	1862.5	8.910	5.744
	K_{96}	80% AW	14823	2120.0	2682.5	6.992	5.525
		60%AW	12760	1980.0	2294.5	6.444	5.561
		40%AW	12093	1200.9	1862.5	10.070	6.492
	K_{120}	80% AW	15100	2120.0	2682.5	7.123	5.629
		60%AW	12700	1980.0	2294.5	6.414	5.534
		40%AW	12167	1200.9	1862.5	10.132	6.532
L/8	K_0	80% AW	9400	2120.0	2682.5	4.434	3.504
		60%AW	9183	1980.0	2294.5	4.638	4.002
		40%AW	8727	1200.9	1862.5	7.267	4.685
	K_{72}	80% AW	12000	2120.0	2682.5	5.660	4.473
		60%AW	11920	1980.0	2294.5	6.020	5.195
		40%AW	10053	1200.9	1862.5	8.371	5.397
	K_{96}	80% AW	15100	2120.0	2682.5	7.123	5.629
		60%AW	13397	1980.0	2294.5	6.766	5.838
		40%AW	12617	1200.9	1862.5	10.506	6.774
	K_{120}	80% AW	16550	2120.0	2682.5	7.807	6.169
		60%AW	13180	1980.0	2294.5	6.657	5.744
		40%AW	12967	1200.9	1862.5	10.798	6.962

Productivity of irrigation water (PIW):

Results in Table (7) cleared that with increasing the irrigation intervals, PIW was increased. Highest average values of PIW 6.962 kg/m^3 for tuber yield, , were obtained under treatment 40% of AW(I_3), while the lowest value(3.355 kg/m^3), were obtained under treatment80% of AW (I_1). These result indicate that increasing irrigation intervals from (I_1) up to (I_3) increased the PIW of tuber yield. The higher values of PIW of (I_3) than that of (I_1) is obviously due to the less amount of the water applied (Wa) under treatment (I_3), as shown in Table (7).

Conclusion

Potatoes are sensitive to water stress thus irrigation has become an essential component of potatoes production in comparison with other crops. Potassium is the nutrient taken up by potatoes in greatest quantity; Therefore, based on water use efficiency values, it is recommended that potato cv. Diamante should be fertilized within (120 K_2O kg/fed.) with irrigation of 80% of available water to achieve the optimum quantity of tuber yield and water productivity.

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تأثير الرى والتسميد بالبوتاسيوم والمسافة من المصرف على محصول البطاطس فى وسط الدلتا

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اجريت تجربتين فى حقل به صرف مغطى بمسافة 20 متر بين الحقليات وعمق 1.2متر فى قرية ابيار مركز كفرالزيات محافظة الغربية وسط الدلتا وذلك لدراسة تأثير كل من البعد من المصرف ومستويات مختلفة من التسميد البوتاسى وكذلك جدولة رى مختلفة على محصول البطاطس ونفذت التجربة فى قطع منشقة مرتين المعاملات الرئيسية المسافة من خط المصرف L/2 , L/4وL/8 والمعاملات تحت رئيسية معدلات التسميد البوتاسى K_2O. 0, 72, 96 , 120 والمعاملات تحت تحت رئيسية الرى عند 40و 60 , 80 % من الماء الميسر

أوضحت النتائج ان :

- بقرب المسافة من المصرف من L/2 الىL/4 الىL/8 يزداد محصول البطاطس زيادة معنوية وفى هذه الدراسة تم تقييم اضافة سماد البوتاسيوم بمعدلات 0 - 72-96-120 كجم K_2Oلكل فدان تحت جدولة رى مختلفة 40-60-80 % من الماء الميسر على محصول البطاطس فى الطينية وكانت النتيجة فى كل حالات الجدولة المتوسطة والعالية اى الرى عند 60-80%

من الماء الميسر اعطت اعلى محصول وكذلك اعلى قيم الاستهلاك المائى بينما كان اقل محصول عند جدولة الرى عند 40 % من الماء الميسر متوسط كميات الماء المضاف خلال موسمى الدراسة 2567- 2101-1787 م3 /للفدان فى الموسم الاول وفى الموسم الثانى كانت 2798 – 2488-1938 م3/للفدان لجدولة الرى 80- 60- 40 % من الماء الميسر

- متوسط الاستهلاك المائى خلال موسمى الدراسة كانت 2120-1980-1200 م3 /للموسم لمعاملات الجدولة 80-60-40% من الماء الميسر على الترتيب
- زيادة معدلات التسميد البوتاسى ادى الى زيادة المحصول تحت كل المعاملات والمستوى الاعلى الثانى 96 كجم /للفدان معنويا تساوى مع المستوى الاعلى 120كجم /للفدان
- اعلى قيمة لانتاج محصول البطاطس وانتاجية الماء والاستهلاك المائى حصل عليها من معاملة التسميد البوتاسى بمعدل اضافة 120 كجم/للفدان واعلى القيم كانت للتسميد البوتاسى الاعلى مستوى تحت جدولة الرى 80% من الماء الميسر اعطى اعلى انتاج خلال موسمى الدراسة

قام بتحكيم البحث

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