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EFFECT OF WATER QUANTITY AND SOME ANTI-TRANSPIRATION RATES ON YIELD AND QUALITY OF SWEET POTATO

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ABSTRACT: *This work was carried out during summer seasons of 2010 and 2011at Gemmeiza Research Station, Gharbia Governorate ,to study the effect of water quantity ratio of crop evapotranspiration (Etc)(125 ,100, 75 . and 50 % of Etc) , anti-transpiration rates (0 , 2 and 4 %) and interaction between them on plant growth , yield components , marketable , non –marketable , total yield and water use efficiency of sweet potato . Data show that increasing the water quantity from 50 to 75 , 100 and125 %, of ETc ; and increasing anti-transpiration rates from 0 %(control) to 2 % and 4 % the vine length (cm) and number of branches / plant increase . Moreover the interaction between water quantity and anti-transpiration rates increase vine length and number of branches / plant. The highest values were obtained under 125% of Etc and 4 % of anti-transpiration rate. Yield components such as number of roots/ plant , yield /plant (gm) and average tuber root weight (gm)were affected by water quantity , anti- transpiration rates and the interactions between them .They were highly when adequate irrigation was applied at 100% of Etc . and under 4% of anti-transpiration rate. Marketable, non-Marketable and total yield were affected by both water quantity , anti-transpiration rates and interaction between them .Their highest values of the previous characters were under adequate irrigation was applied water at 100 % of Etc .Increasing anti- transpiration rates marketable yield increase. Meanwhile the non-marketable yield decreases when increasing the water applied and the anti-transpiration rate . Water use efficiency (WUE) was increase by decreasing water quantity ,and by increasing the anti-transpiration rates*

Key words: *Sweet potato growth, marketable, non-marketable yield, water use efficiency, surface irrigation.*

INTRODUCTION

Water resources in Egypt have become limited in view of the necessity to reclaim new lands. In such new reclaimed lands, which are located in arid and semi-arid regions, the limiting factor for maximizing the benefit of cultivation is water. The increase in water use efficiency could be achieved by applying the proper quantity and frequency of irrigation in accordance with soil properties and climatic parameters , also moisture stresses at critical stage of plant growth should be avoided .This requires a better knowledge of evapotranspiration rates and crop water regime .

Sweet potato is seventh most important food crop around the world after, wheat, rice, potato, barley. It is the fourth most important food crop in developing tropical countries and it is grown in most of the tropical and subtropical regions of the earth, where the the vine , as well as the roots, is consumed by humans and livestock Woolfe, (1992).

Irrigation water quantity had a significant effect on vine length, Number of branches / plant and total yield of sweet potato. Irrigation of sweet potato plants with 2500 m/ fed. as SSD irrigation system gave the highest values for all plant growth characters and recorded the highest yield quantity and quality of sweet potato El-Sayed *et al.,* (2011) Abdel- Fattah *et al.,* (2002), Found that in sweet plants , water stress reduced the growth as, main stem length, number of branches , weight per plant , yield as tubers number/ plant , total and marketable yield. Kumar *et al.,* (2007b) obtained higher total marketable, jumbo size and colossal yield

with watered treatments .Deficit (or regulated deficit) irrigation is one way of maximizing water use efficiency (WUE) for higher yield per unit of applied irrigation water. Mermoud *et al.,* (2005) appropriate management of irrigation is a vital importance to preserve water resources , qualitatively ,and to produce more food with the available water . Solomon (1993) . illustrated that managing irrigation water and plant nutrients are the major challenge of sandy soil amelioration efforts since ,insufficient irrigation water results of high soil moisture tension , which fall under stress and , in turn ,reduce its yield while excess irrigation water may reduce crop yield due to leaching of applied nutrients increased disease incidence and /or failure to stimulate growth of the commercially valuable parts of the plant . Amer (2010) found that , maximum yield of 9.12 Mg /ha was achieved by 325 mm adequate irrigation quantity. Yield reduction (1-Y /Ym) was linearly decreased in rate of 1.15 by increasing water deficit fraction (1-u /d) in complete deficit irrigation in range of 0.6 to1.0 of Etc , where Y is the corresponding yield achieved by irrigation quantity u . He found ,also, that the crop yield was linearly decreased in surplus areas by increasing irrigation water quantity ranged from 1.0 to 1.4 of Etc..

Previous research were studied the effect of humic acid as anti-transpiration, Nermeen (2011) found that humic acid spray decrease the effect of water stress on the plant leads to forming soft cuticle layer on the plant and closing the stomata partly which decreases the losing water by transpiration and increases the photosynthesis process so increases the yield Kava (2005) found that, humic acid spry increasing The process of photosynthesis and forming carbohydrates and proteins. Awad and El-gharmy (2007) found that. humic acid had significant effect on vegetative growth and yield of potato plants. Chen and Aviad (1990) demonstrated that humic materials led to increase the permeability of plant membranes, promote the uptake of nutrient, increase soil moisture holding capacity, reduce impacts of disease and stimulate plant growth.

The objective of this research is study the effect of the irrigation water quantities as well as anti-transpiration (humic acid) on plant growth, water use efficiency and the yield of sweet potato under Middle east of Delta region.

MATERIALS AND METHODS

Two field experiments were carried out on sweet potato plant during two summer seasons of 2010 and 2011 at the Experimental Farm of Gemmeiza Research Station, Gharbia Governorate, to study the effect of irrigation regime and some Anti transpiration levels as well as their interactions on growth ,plant water relations, yield and its quality as well as water use efficiency under clay soil conditions . The physical and chemical properties of experimental soil are shown in Table (1) .

Table (1): Mechanical analysis and some soil moisture contents of the studied experimental soil.

Depth cm	Fine sand%	Coarse sand%	Silt%	Clay%	Soil texture	F C.%	W.P.%
0-15	3.30	20.70	27.00	49.00	Clay	42.00	21.30
15-30	3.75	20.65	27.50	48.10	Clay	42.50	20.50
30-45	3.85	20.35	28.45	47.35	Clay	43.70	21.90
45-60	4.55	20.45	28.25	46.75	Clay	44.30	22.50

The present trial aims to investigate how irrigating sweet potato crop, according to some water quantity(50,75 ,100 and 125% of ETc) and anti- transpiration levels (0, 2 and 4 %) , as well as their interactions on yield ,crop water use and water use efficiency . Anti- transpiration was added as foliar application two times after 45 and 65 days from transplanting .

Stem cutting about 20 cm in length of sweet potato plants were transplanted on the third top slope ridges at 30 cm a part on May1 st and 5 th in the1 st and 2 nd seasons of 2010 and 2011 , respectively. The experimental design was split plot in completely randomized with three replicates, irrigation levels arranged in the main plots , while anti- transpiration rates was arranged at random in the sub plots . All recommended agricultural practices (i.e. fertilization, weed control ...etc) for sweet potato production in Gemmeiza area were done according to the general program of sweet potato cultivation. Plants were irrigated by traditional surface irrigation. Stages, Kc, Eto and intervals of irrigation as shown in Table (2). Tuber roots were harvested on Sep. 30 in both 2010 and 2011 seasons .

The treatment were arranged as fallows:
Main treatments (Water quantity)
Irrigation water at 125 % of ETc
Irrigation water at 100 % of ETc
Irrigation water at 75 % of ETc
Irrigation water at 50 % of Etc

Sub main treatment (Foliar application of humic acid as .Anti-transpiration)
Control at 0%
Concentration at 2%
Concentration at 4 %

Irrigation water calculations:
Traditional irrigation system.
Irrigation water was delivered to the plots through a circular orifice (Fig.1) and water quantity was measured using the formula of immersed orifice according James (1988) as follow

$$Q = 0.61\ K\ AH^{0.5}$$

Where:
Q =Orifice discharge L/sec.
A = The area of orifice opening (cm^2)
H= Effective water head over the orifice center (m.)
K= Unit constant (K=0.443 for Q in L/sec, A in cm^2, and H in m)

Pan evaporation management.
Reference evapotranspiration (ETo) was calculated according to (Doorenbos and Prutt (1977): as follow:
ETo = Kp x Epan
Where :
ETo = reference evapotranspiration (mm / day)
Kp = pan coefficient
Epan = pan evaporation (mm)
Etc = ETo x kc

Where:
ETc = crop consumptive use (mm/day**).**
Kc = crop coefficient, (dimension less).

Table (2): Stages ,Kc and intervals of sweet potato .

Stages	Stage Period day	Months	Kc	ETo	Intervals	Irrigation No.
Initial	25	May	0.5	6.5	12	2
Vegetative	30	Jun	0.75	6.8	15	2
Mid-season	30 15	July Og.	1.05	7.0	15	3
Maturity	15 15	Og. Sep	0.75	6.7	15	2
Harvesting	15	Sep.	0.65	6.4	-------	--

Fig. 1 : Irrigation orifice

Vegetative growth characters:

A sample of three plants were taken at random from each treatment at 110 days after transplanting to measure each of vine length (cm) and number of branches / plant.

Yield and its components :

At harvesting tuberous roots of each treatment were classified according to Grang (1963) into two grades (marketable and non-marketable roots). Marketable roots have a weight 100 to 250 gm, while non-marketable roots have a weight of less than 100gm or more than 250 gm, then weighted to determine total yield (ton / fed.) . In addition average tuber weight (g) and tuber yield (kg) were calculated per plant .

Water use efficiency (WUE)

It was determined by dividing the tuber roots yield ton /fed. By water quantity m^3 /fed. and expressed as kg tuber roots / m^3 water, (Begg and Turner (1976)).

RESULTS AND DISCUSSION

Effect of water quantity on Sweet potato growth:

Data Table (3) illustrate the effect of quantity of irrigation water on growth of sweet potato .The highest values of vine length (cm) and number of branches / plant were 128.65, 24.08 for the first season and , 123,52 and 22,15 for the second season and they occurred when using 125%of ETc .In the first and the second seasons data show , also that, by decreasing the amount of water from 125% to 50 % the vine length (cm) and number of branches /plant were decrease , the percentage of decreasing were 3.66 , 7.5 , 11.37, 6.89,16.99 and 25.96 % respectively . The same trend was obtained in the 2 nd season, the percentage of decrease for vine length (cm) and number of branches /plant were ,3.09 , 7.84, 9.79 and 11.38, 20.50 and 38.06 % ,respectively when water amount was decrease to 100, 75 and 50 % of ETc. These results agreement with those of Abdel- Fattah *et al*., (2002) who found that in sweet potato plants, water stress reduced growth as, main stem length and number of branches / plant .

Effect of anti –transpiration rates on sweet potato growth:

Data in Table (4) show that , increasing the anti- transpiration rates from 0% (control), to 2 % and 4 % the growth of sweet potato plants were increase ,the percentage of vine length and number of branches / plant were 1.48 ,5.96 , 5.78 and 13.10 % respectively for rates of 2 % and 4 % compared by control in the 1 st season . The same trend was found in the 2 nd season, where the percentage of increase were 1.90, 3.40, 5.98 and 15.56%, respectively, for increasing anti-transpiration rate from 2% and 4% compared to 0 % (control).

Table (3): Effect of water quantity on some growth characters of sweet potato during the two seasons 2010 and 2011 .

Irrigation treatments ETc	1st season		2nd season	
	Vine length (cm)	No. of branch /plant	Vine length (cm)	No. of branch /plant
125 %	128.65	24.08	123.52	22.15
100 %	123.94	22.40	119.70	19.63
75%	119.00	19,99	113.83	17.61
50 %	114.00	17.83	111.43	13.72

Table (4): Effect of anti-transpiration rates on plant growth of sweet potato during the two seasons of 2010 and 2011.

Anti-transpiration Treatments	1st season		2nd season	
	Vine length (cm)	No. of branches /plant	Vine length (cm)	No. of branches /plant
0 %	117.78	19.685	115.032	16.745
2 %	119.550	20.893	117.258	17.810
4 %	125.245	22.653	119.075	19.830

Effect of the interactions of the treatments on sweet potato growth:

Data in Table (5) show the effect of the interactions between quantity of water and anti- transpiration rates on growth of sweet potato(vine length cm and number of branches / plant) , at all treatments of irrigation water and rates of anti-transpiration , growth of sweet potato plants was increase by increasing each of anti-transpiration rates and water quantity . The best values for vine length (cm) and number of branches /plant were observed with the interactions between quantity of water at 125 %of ETc and 4 %of anti-transpiration in the 1st and the 2nd seasons (132.31, 25.62, 125.20 and 23.51, respectively). While the lowest value was obtained with interactions between 50 %of Etc and 0%(control) of anti-transpiration. Their values were 110.5 , 16.50 ,109.8 and 12.5 for vine length (cm) and number of branches/ plant ,in the 1st and the 2nd seasons, respectively .

Effect of water quantity on the yield components

Table (6) show the effect of water quantity on yield components of sweet potato plants such as, number of roots / plant ,yield/ plant (gm) and average tuber root weight (gm) .The maximum yield components values were 4.93 .996.95 and 202.08 resp for the previous character. in the 1st season and obtained when using 100%of ETc . The obtained results were in accordance with those obtained by Amer (2011) . While when water quantity was decrease from 100 to 75 and 50 % of ETc, the yield components decrease. The percentage of decreasing were 7.51.19.68, 15.22, 44.25, 8.45 and 13.40%for number of roots /plant ,yield plant (gm) and average tuber root weight (gm) .under decrease water quantity . The percentage of decreases were 14.78 ,22.27 , 17.78 ,43.05, 3.56 and 8.02 %respectively, for number of roots /plant ,yield plant (gm) and average tuber weight (gm) under quantity of 75 and 50 % compared by 100% of Etc .

when water quantity was increase to125%of Etc, number of roots / plant ,yield plant (gm) and average tuber root weight (gm) decrease comparing to100% of Etc with about 5.27, 9.34and 4.57%resp., in the 1 st season . The same trend was observed in the2 nd season is occurred and the percentage of decreasing was 8.57 , 10.35 and 2.01 % resp .for number of roots /plant, yield plant (gm) and average tuber weight (gm) , respectively. These results may be excessive water irrigation (125% of Etc) leaching fertilizer in groundwater .

Table (5): Effect of the interactions between quantity of water and rates of anti-transpiration on growth of sweet potato plants during the two seasons of 2010 and 2011 .

Irrigation treatments ETc	Anti-transpiration rates	1 st season		2 nd season	
		Vine length (cm)	No.of branches/ /plant	Vine length (cm)	No.of branches /plant
125 %	0%	125.10	22.90	120.63	20.31
	2%	128.53	23.73	124.73	22.51
	4%	132.31	25.62	125.20	23.51
100%	0%	120.67	21.00	118.30	18.50
	2%	*122.67*	*21.84*	*119.60*	*19.10*
	4%	128.47	24.37	121.20	21.30
75%	0%	115.3	18.34	111.40	15.67
	2%	119.2	20.00	113.50	17.50
	4%	122.5	21.62	116.60	19.65
50%	0%	110.5	16.50	109.80	12.50
	2%	113.8	18.00	111.20	13.81
	4%	117.7	19.00	113.30	14.86

Table (6): Effect of quantity of water on yield and its components of sweet potato plants during the two seasons of 2010 and 2011 .

	1 st season			2 nd season		
Irr. Treat. ETc	No. of roots/plant	Yield plant (gm)	Average tuber root weight (gm)	No. of roots/plant	Yield plant (gm)	Average tuber root weight (gm)
125%	4.67	903.61	192.85	4.27	783.73	183.33
100%	4.93	996.65	202.08	4.67	874.25	187.08
75 %	4.56	844.94	185.00	3.98	718.8	180.42
50 %	3.96	555.67	175.00	3.63	497.08	172.08

Effect of anti-transpiration rates on yield components:

Regarding the effect of anti-transpiration rates on yield components of sweet potato i.e, number of roots /plant ,yield plant (gm) and average tuber root weight (gm), are shown in Table (7) . Data show that increasing anti-transpiration rates from 0 to 2 or 4 %, the values of yield components such as number of roots /plant and yield /plant (gm) were increase . The percentage of increasing were about 6,11 , 8.70, 9.11 , 14.07 , 3.17 and 6.13 % for number of roots /plant , yield / plant and average tuber root weight , respectively, in the 1 st season . The percentage of increasing in the 2 nd season were about 3.62 , 6.78 , 6.25 , 11.85 , 3.10 and 5.22 %,respectively for number of roots /plant ,yield /plant and the average tuber root weight. This result in agreement with Chen and Aviad (1990) who which demonstrated that, humic materials led to an increase in the permeability of plant membranes, promote the uptake of nutrient, increase soil moisture holding capacity, reduce impacts of disease and stimulate plant growth.

Effect of the interactions of the treatments on the yield components:

Data in Table (8) illustrate the interactions between water quantity and anti- transpiration rates on components of sweet potato yield (number of roots / plant , yield/ plant (gm) and average tuber root weight (gm)) . The highest values was of the previous characters was obtained by the interactions between water quantity at 100% of Etc and anti-transpiration rate of 4 % (their values were 5.01,1052.1 and 210 in the 1 st season),. and 4. 81 , 931.94 and 193.75 for number of roots /plant, yield plant(gm) and average tuber root weight (gm), respectively in the 2 nd season .Data show, also that when water quantity was decrease, the components of yield decrease. In this case may be the plant forwarded to vegetable growth ,so both increase or decrease water quantity from 100% of Etc interaction between anti-transpiration rates will decrease the yield components of sweet potato .

Effect of water quantities on the marketable and non-marketable yield:

Table (9) show the effect of water quantities on the marketable and non-marketable yield of the sweet potato. Data showed that the highest values of the marketable yield of sweet potato were 17.21 and 15.77 ton /fed. During the 1 st and 2 nd seasons resp. , under 100% of ETc treatment . It is , also , noticed that the marketable yield decreases with about 12.09 and 33.05 % under the treatments of 75 % and 50 %of ETc , resp. comparing with the data at 100 %of ETc treatment during the 1 st season . Moreover, the same trend was noticed in the 2 nd season ,but the decreasing percent were about 7.01 and 24.98 % under the treatments of 75 % and 50 % ,resp. comparing with the yield at 100 % of ETc treatment . Meanwhile , results illustrated that the non- marketable yield was the lowest at the treatment of 100 % of ETc where it increases under the other water quantity treatments of 125 , 75 ,and 50 % ETc than that at the treatment of 100 % of ETc with about 23,28, 32.96 and 42.89 % resp. in the 1 st season and with about 18.78 , 27.94 and 31.45 % ,resp. in the 2 nd season . These results accordant with El-Sharkawy *et al* . (2006) whose illustrated that by adequate water irrigation through alternate- furrow irrigation ,non -marketable minimized compared to traditional irrigation of onion crop.

Table (7): Effect of anti-transpiration rates on yield and its components of sweet potato during the two seasons 2010 and 2011 .

	1st season			2nd season		
Anti transpiration Treat.	No. of roots/plant	Yield/ plant (gm)	Average tuber root weight (gm)	No. of roots/plant	Yield/ plant (gm)	Average tuber root weight (gm)
0%	4.30	758.48	182.76	3.99	672.90	175.63
2 %	4.58	834.49	188.75	4.14	719.80	181.25
4 %	4.71	882.68	194.69	4.28	763.34	185.31

Table (8): Effect of the interactions between quantity of water and rates of anti-transpiration on yield components of sweet potato during the two seasons of 2010 and 2011.

Irr. Treat. ETc	Anti-transpiration rates	1st season			2nd season		
		No.of roots/plant	Yield/ plant (gm)	Average tuber root weight (gm)	No.of roots/ plant	Yield/ plant (gm)	Average tuber root weight (gm)
125%	0%	4.31	802.62	184.4	4.19	743.73	177.50
	2%	4.75	920.22	193.75	4.25	786.25	185.00
	4%	4.94	988.00	200.00	4.38	821.25	187.50
100%	0 %	4.84	949.85	196.25	4.54	822.88	181.25
	2%	4.94	988.00	200.00	4.66	867.93	186.25
	4%	5.01	1052.1	210.00	4.81	931.94	193.75
75%	0 %	4.19	759.43	181.25	3.75	656.25	175.00
	2%	469	873.50	186.25	4.00	725.01	181.25
	4%	4.81	901.88	187.50	4.19	775.15	185.00
50%	0 %	3.87	522.00	168.75	3.5	468.75	168.75
	2%	3.94	556.25	175.00	3.63	500.00	172.5
	4%	4.09	588.75	181.25	3.75	525.00	175.00

Table (9): Effect of quantity of water on marketable ,non – marketable and total yield of sweet potato tuberous roots during the two seasons of 2010 and 2011 .

Irr. Treat. ETc	1st season			2nd season		
	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield Ton/fed	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield ton/fed.
125%	15.29	0.670	15.96	13.94	0.703	15.64
100%	17.21	0.514	17.72	15.77	0.571	16.34
75%	15.13	0.766	15.90	14.65	0.713	15.36
50 %	11.47	0.900	12.37	11.83	0.833	12.66

Table (9) show that, by increasing or decreasing water quantities from 100 %of Etc total tuberous root yield decrease, the percentage of decreases were 10.08 , 10.42 and 30.31 % for 125 , 75 and 50% ETc compared to 100 %in the 1st season. The percentage of decreasing in the 2nd season were 4.28 , 6.00 and 22.52 % of 125 , 75 and 50 % of ETc compared to 100 % ETc .These results were agreement with obtained by Solomon (1993) who illustrated that ,insufficient irrigation water results of high soil moisture tension , which fall under stress and , in turn reduce its yield while excess irrigation water may reduce crop yield due to leaching of applied nutrients, increased disease incidence and /or failure to stimulate growth of the commercially valuable parts of the plant .

Effect of anti- transpiration on marketable and non-marketable yield :

The effect of anti- transpiration rates on marketable and non- marketable yield (ton /fed.) of the sweet potato are shown in Table (10) .Results show `that increasing the anti-transpiration rates from 0 %(control) to 2 % and 4 % , increase the marketable yield with about 5.47 and 9.74 % , respectively , in the 1st season . Meanwhile , in the 2nd season , these increase percent values were about 2.48 and 5.73 % comparing with the control (at 0 % of anti- transpiration treatment) . Moreover, increasing the anti- transpiration rates decreased the non- marketable yield with about 14.00 and 21.19 % in the 1 season but with 8.22 and 15.40 %in the 2 season , also , data show that by increasing the anti- transpiration rates . The total yield (ton / fed.) increases with about 4.45 , 8.30 , 2.27, and 4,70 % for 2 and 4 % treatments compared to 0 %in the 1 and 2 seasons , respectively . These result agreement with Awad and El-ghamry (2007) where they found that humic acid had a significant effect on the vegetable growth and yield of potato plants .

Effect of the interactions of the studied treatments:

The effect of the interactions between water quantities and anti- transpiration rates treatments on the marketable, non-marketable yield during the two studied seasons, are shown in Table (11). Data show that under all treatments of irrigation, increasing the anti-transpiration rates, increase the marketable yield .It was found that the highest of the marketable yield was about 18.09 and 16.04 ton / fed.in the1st and the 2nd seasons ,resp. These values are accrued at the treatment of 100 % of ETc and 4 % of anti- transpiration. While the lowest values under the interactions of the treatments was occurred at 50 % of Etc and 0 % (control) of anti-transpiration rate treatment (13.56 and 12.25 ton /fed in the 1st and the 2nd seasons) .

Table (10): Effect of the anti- transpiration rates on the marketable ,non – marketable and total yield of sweet potato tuberous roots during the two seasons of 2010 and 2011.

	1st season			2nd season		
Anti-trans Treat.	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield ton /fed.	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield ton /fed.
0%	14.00	0.807	14.81	13.88	o.766	14.648
2%	14.81	0.694	15.50	14.285	0.703	14.988
4%	15.51	0.636	16.15	14.723	0.648	15.370

Table (11): Effect of the interactions between quantity of water and anti-transpiration rates on total marketable and non-marketable yield of sweet potato tuberous roots during the two seasons of 2010 and 2011.

		1st season			2nd season		
Irr. Treat. ETc	Anti-transpiration rates	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield ton /fed.	Marketable Yield ton/fed.	Non-marketable yield ton/fed.	Total yield ton /fed.
125%	0 %	14.67	0.772	15.44	14.58	0.768	15.35
	2%	15.24	0.635	15.88	14.79	0.697	15.49
	4%	15.96	0.603	16.56	15.45	0.644	16.09
100%	0 %	16.20	0.675	16.88	15.47	0.644	16.11
	2%	17.34	0.456	17.88	15.81	0.573	16.38
	4%	18.09	0.410	18.50	16.04	0.496	16.54
75 %	0 %	14.53	0.846	15.38	14.23	0.770	15.00
	2%	15.02	0.791	15.81	14.57	0.710	15.28
	4%	15.84	0,660	16.50	15.15	0.660	15.81
50%	0 %	10.615	0.936	11.551	11.25	0.880	12.13
	2%	11.633	0.895	12.528	11.97	0.830	12.80
	4%	12.164	0.870	13.034	12.25	0.790	13.04

Data in Table (11) show the effect of the interactions between water quantity and anti-transpiration rates on non – marketable yield ,it is clear that, under all treatment of irrigation, increasing anti-transpiration rates decrease non–marketable yield . The interaction between water quantities of 100 % of Etc and 4 % of anti-transpiration gave the lowest values of non-marketable yield, it produced 0, 410 and 0.496 ton / fed.in the 1st and the 2nd seasons, resp. while the interaction between water quantities at 50 % Etc and anti-transpiration rate of 0 %(control) gave

the highest values of non-marketable yield these values were 0. 936 and 0.880 ton/fed. in the 1 st and the 2 nd seasons, resp.

Effect of the interactions between water quantities and anti- transpiration rates on total yield (ton /fed.) were shown in Table (11). the highest values were 18.50 and 16.54 ton / fed . for the interaction between 100 % of Etc and 4 %of anti-transpiration rate in 1 st and the 2 nd seasons . Increasing or decreasing water quantities decrease total yield (ton /fed.) Therefore 4 %of anti –transpiration rate recommended under water quantity 100 % of Etc .

Water use efficiency (WUE)

Table (12) show the effect of water quantities and anti-transpiration rates on the water use efficiency (WUE). When the irrigation water decrease from 125%to 100%,75% and 50 % water use efficiency (WUE) increase from 4.95 to 6.90, 8.23 and 9.52 kg/ m ^{3} in the 1 season. The same trend in the 2nd season has happened and WUE increases from the values were 4.86 to 6.35, 7.95 and 9.73 kg/ m ^{3}resp..These results are In agreement with those of Kumar *et al.,* (2007b**)** .whose is started that obtained ,deficit (or regulated deficit) irrigation is one way of maximizing water use efficiency (WUE) for higher yield per unit of applied irrigation water .

Moreover, data, in Table (12) illustrated that *when anti –transpiration rate* increase from 0 to 2 and 4 %, the water use efficiency increase from 6.56 to 6.87 and 7.32 kg/ m ^{3}in the 1 st season resp.. Meanwhile the W.U.E. values increases from 6.49 to 6.64 and 6.81 kg / m ^{3} respectively ,in the 2 nd season .

Conclusions

The effect of irrigation quantities, anti-transpiration rates and their interactions needs to management of water , maximization marketable ,yield and water use efficiency . The main results in the present work can be summarized and concluded in the following points: The highest values of vine length (cm) and number of branches / plant was occurred at the treatment 125%of ETc. Increasing the anti- transpiration rates from 0% to 2 and 4 %, increase the vine length and the number of branches per plant.

The maximum yield components was noticed when using 100% of Etc (4.93 , 996.95 and 202.08 for number of roots / plant ,yield / plant (gm) and average tuber root weight (gm) resp.) . and when using anti-transpiration rates 4 %(4.50, 823.01, 190and16.13 for number of roots / plant ,yield / plant (gm) and average tuber root weight (gm) resp) . By applied adequate irrigation water 100 %of ETc, the maximum average of the marketable and total yield of sweet potato were obtained for the two studied seasons (16.49 and 17.05 ton /fed.resp. Otherwise, the average of the two studied seasons of the non-marketable yield was the smallest about (0.543 ton /fed.) . Marketable and total yield were higher when applied 4 % of anti-transpiration rate the average values were 15.12 and 15.76 ton /fed. while decrease non-marketable yield average value was 0.642 ton /fed.. Water use efficiency (WUE) increased by decreasing the water quantity and increasing anti-transpiration rates .

Table (12): Effect of water quantities and anti- transpiration treatments on water use efficiency of sweet potato during the two seasons of 2010 and 2011 .

Irrigation. Treatments ETc	WUE Kg / m ^{3}		Anti-Transpiration rates	WUE Kg / m ^{3}	
	1 st season	*2 nd season*		*1 s season*	*2 nd season*
125%ETc	4.96	4.84	0%	6.56	6.49
100% Etc	6.89	6.35	2%	6.87	6.64
75% Etc	8.23	7.95	4%	7.32	6.81
50% Etc	9.51	9.73			

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تأثير كمية مياه الرى وبعض معدلات مضاد النتح على انتاجية وجودة البطاطا.

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الملخص العربى

أجرى هذا البحث فى صيف موسمى ٢٠١٠ و ٢٠١١ فى مزرعة محطة بحوث الجميزة بالغربية ؛ بهدف دراسة تأثير كمية مياه الرى ، ومعدلات مضاد النتح على طول الفرع و عدد الافرع لكل نبات وجودة الجذور ومكونات المحصول (عدد الجذور / النبات ومحصول النبات(جم) و متوسط وزن الجذر(حم)) والمحصول القابل للتسويق والمحصول غير قابل للتسويق والمحصول الكلي لمحصول البطاطا وكدلك كفاءة استخدام المياه فى الوادى .

أدت زيادة كمية المياه من ٥٠الى٧٥و١٠٠و١٢٥% ادت الى زدياة كلا من طول الفرع وعدد الافرع / النبات كذلك ادت زيادة تركيز مضاد النتح من صفر الى ٢ و ٤ % الى زيادة طول الفرع وعدد الفرع/ النبات.

وكان أعلى طول للفرع وعدد الافرع / النبات نتيجة التداخل بين كمية المياه وتركيز مضاد النتح تحت كمية المياه ١٢٥% من البخرنتح وتركيز مضاد النتح ٤% .

كما أوضحت النتائج أن عدد الجذور / النبات ومحصول النبات و متوسط وزن الجذر تتأثر بكل من كمية مياة الرى ومعدل تركيز مضاد النتح .

وكانت اعلى قيم لمكونات المحصول مثل عدد الجذور / النبات و محصول النبات و متوسط وزن الجذر باستخدام كمية المياه ١٠٠ % من البخر نتح.

زيادة معدل مضاد النتح أدى الى زيادة عدد الجذور / النبات ومحصول /النبات و متوسط وزن الجذر.

و أعطى التداخل كمية المياه ١٠٠% من البخر نتح ومعدل تركيز مضاد النتح ٤% اعلى عدد للجذور/ النبات ومحصول / النبات ومتوسط وزن الجذر .

أدى استخدام كمية مياه الرى ١٠٠% من البخر نتح الى الحصول على اعلى انتاجية من المحصول القابل للتسوق وكدلك المحصول الكلى وعلى العكس الحصول على اقل محصول غير قابل للتسويق .

أدت زيادة تركيز مضاد النتح الى زيادة المحصول القابل للتسويق واالمحصول الكلى والحصول على اقل محصول غير قابل للتسويق .

ادت زيادةكمية المياه اللى نقص كفاءة استخدام المياه وعلى العكس زيادة تركيز مضاد النتح ادى الى زيادة كفاءة استخدام المياه .

ونوصى للحصول على اعلى محصول القابل للتسويق و محصول كلى واقل محصول غير قابل للتسويق واعلى كفاءة لاستخدام المياه استخدام كمبة المياه ١٠٠% من البخر نتح والرش بمضاد النتح بتركيز ٤ % تحت ظروف منطقة اجراء البحث .