OF SURFACE IRRIGATION SYSTEMS ON YIELD AND YIELD COMPONENTS OF AUTUMN SUGAR CANE AND TOMATO INTERCROPPED

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ABSTRACT

This work was carried out to study the effect of modified surface irrigation by using gated pipes and intercropping patterns on yield and yield components of sugarcane and tomato. Two field experiments were conducted at Khreat farm, Kom Ambo city, Aswan Governorate in 2003/2004 and 2004/2005 seasons in clay soil.

The results are summarized as follow:

1- Values of stalk height, stalk diameter, number of millable stalks / fed, cane yield /fed, and W.U.E. were increased by using gated pipes irrigation. The cane yields were increased by 11.93 and 11.07% in the two seasons respectively. While the water applied m^3/fed were reduced by 13.94 and 14.85% also the W.U.E. were increased by 25.33 and 24.93% in the same seasons respectively.

2- The cane yield intercropped with tomato were reduced by 6.37, 13.52% and 7.48 and 15.98% less than the pure stand of one row and two rows tomato in both seasons respectively.

3- The cane yield were 52.67, 47.32 ton/fed and 51.27, 43.36 ton/fed when intercropped with one row and two rows of tomato in gated pipes system in the two seasons respectively compared with 48.38 and 47.15 ton/fed for pure stand sugarcane in traditional surface irrigation in the two seasons respectively. The water applied m^3/fed was reduced by using intercropping tomato with sugarcane under irrigation system. It was 7115, 7226.67 m^3/fed and 7065, 7073.33 m^3/fed for one row and two rows in the two seasons respectively compared with 8120, 8083.33 m^3/fed for pure stand sugarcane under traditional surface irrigation in the two seasons.

4- The fruits damage % was affected by interaction between gated pipes systems and intercropping it was 10.97, 11.48 and 12.48% and 11.07, 12.20 and 12.10% for one row, two rows and solid tomato in the two seasons respectively. Marketable yield ton/fed followed the same trend. It was increased by using gated pipes systems and intercropping, it was increased in the two seasons compared with solid tomato in the traditional irrigation. It was 23.16 , 24.95 ton/fed and 22.38 , 22.64 ton/fed for one row and two rows tomato in the two seasons respectively compared with 35.98 and 33.95 ton/ fed for solid tomato in the traditional irrigation in two seasons respectively.

5- The LER value for sugarcane intercropped with one row and two rows of tomato were 1.81 and 1.87 respectively for gated pipes system while it was 1.72 and 1.75 for one row and two rows tomato for traditional surface irrigation respectively.

6- The sugarcane intercropped with one row tomato under gated pipes gave the highest total income, (10663.35 L.E.) while the sugar cane intercropped with two rows tomato under traditional irrigation gave the lowest total income, (9113.30 L.E.).

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INTRODUCTION

Gated pipes is a way to increase the surface irrigation methods which has low on- farm water application efficiency (40 – 60%), also agricultural intensification is considered the main approach to achieve the economic growth. Also intercropping generally produces more total yields of the mixed crops per unit area.

Kholeif et al (1997) showed that modern irrigation systems in sugarcane under upper Egypt conditions gave the highest cane yield and quality. Also, he reported that the improved surface irrigation in strips as it was less in initial investment, easily managed and suits the skills in the sugarcane area. Meanwhile water saving was (31%) compared with conventional method. **Osman (2000)** concluded that good design of gated pipes with a precision land leveling improved the water distribution uniformity and saved irrigation water by 12% and 29.24% in cotton and wheat respectively. While cotton and wheat yield increased by 64.3 and 91.7% respectively compared by traditional surface irrigation systems. **El-Tantawy et.al, (2000)** showed that the water applied through perforated pipe decreased by (12.19, 18.64 and 23.22%) and (12.92, 18.91 and 23.50%) under different discharge of 0.6, 0.8 and 1.00 l/s, compared with traditional irrigation in both seasons respectively. He added that the crop yield increased by (9.0, 11.2 and 13.1%) and 14.9, 17.3 and 19.0%) under different discharge of 0.6, 0.8 and 1.00 l/s, compared with traditional irrigation in both seasons respectively. Also the water use efficiency for sugar weight increased by (17.5, 32.5 and 40.0%) and (30.23, 44.18 and 58.13%) under different discharge of 0.6, 0.8 and 1.00 l/s, compared with traditional irrigation in both seasons respectively. **Osman (2002)** showed that using gated pipes, acquired the highest cotton, wheat, corn and rice yield (61.1, 65.2, 116 and 53.6%) irrigation technique. Meanwhile water saving was (29.64, 29.9, 14.5 and 19.7%) in cotton, wheat, corn and rice compared with traditional system. **Eweida,et al.,(1996)** showed that yields of intercropped soybean, wheat, maize, and soybean with sugarcane raised the land use capacity by 50, 70, 30 and 40% respectively. Also the high values of the relative crowding coefficient (K) indicated a distinct yield advantage form intercropping these crops with sugarcane. **Zohry (1997**) concluded that sugar cane yield was significantly affected by onion intercropping. The average yield of cane was reduced by about 9.9 and 8.4 %compared with pure stand in first and second seasons, respectively. Birx, sucrose and purity percentages of sugar cane juice showed significant differences between treatments. Intercropping onion with sugar cane increased the land usage by 43- 59%. **Abd El_Aal and Zohry (2003)** mentioned that intercropping tomato with maize saved irrigation water by 40% compared with solid treatments. Tomato fruits were significantly affected by intercropping tomato with maize, phosphate source and doses. The damage of tomato fruits was decreased and marketable yield increased. These could be attributed to the height of maize plants that acts as shadow on tomato plants and protect fruits from sunrays and reduce the effect of direct burning on fruits. He added the most advantage for using intercropping is to maximize usage unit of land and water to produce a maximum production.

MATERIAL AND METHODS

Two field trials were conducted at khraat valley, Aswan Governorate in two successive seasons (2003/2004 – 2004/2005) to investigate the effect of using surface irrigation system with gated pipes and intercropping tomato (c.v. Castle rock) with sugar cane (c.v. G. T. C.54/9) on the water requirements, yield and yield components of sugar cane and tomato. Treatments were arranged in a split plot design with four replications. Methods of surface irrigation occupied the main plots, whereas intercropping occupied plots.

The treatments as follows:

1- Iintercropping one row of tomato on sugar cane ridge.
2- Iintercropping two rows of tomato on sugar cane ridge.
3- Pure stand sugar cane.
4- Solid tomato.

The plot was 2250 m^2 and consisted of 24 ridges.
Sugar cane was planted on October, 20^{th} and 27^{th} in the first and the second season, respectively, Transplanting of tomato were on 25^{th} and 29^{th} of November in the first and the second season, respectively.
All the experimental treatments received the same agricultural practices as recommended. Before starting the experimental work soil analysis was recorded. Table (1) shows the results of the mechanical analysis and the bulk density of the soil. Field capacity was 39.6 % by weight and the wilting point was 18 % by weight.

Table (1): Mechanical analysis and the bulk density of the different layers of the experimental area

Depth Cm	Coarse sand %	Fine sand %	Silt %	Clay %	Texture class	Organi %	$CaCo_3$	Bulk density cm^3
(0-15)	4.67	15.96	18.89	60.48	Clayey	5.50	3.50	1.10
(15-30)	4.50	13.50	19.0	63.00	Clayey	5.00	4.00	1.09
(30-45)	4.90	14.00	18.6	62.50	Clayey	2.00	3.90	1.15
(45-60)	3.50	15.50	16.0	65.00	Clayey	2.00	3.50	1.15

Methods of calculations:

Water use efficiency (kg/ m^3):

WUE = yield (kg/fed) / total applied water (m^3/fed)

Land equivalent ratio (LER)

Land Equivalent Ratio was calculated according to **Willey, 1979.** LER was determined as the sum of the fractions of the yield of the intercrops relative to their sole crop yields .LER was determined according to the following formula:

$$LER = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

Where:
Yaa = Pure stand yield of species a.
Ybb = Pure stand yield of species b.
Yab = Mixture yield of a (when combined with b).
Yba = Mixture yield of b (when combined with a).

Statistical analysis:

Data of the two seasons were statistically analyzed according to **Snedecor and Cochron (1988)** using Mstatc computer V_4 (1986). L.S.D. test at 0.05 level, was used to compare the differences between treatments.

Net return:

Net return was calculated according to prices by the Ministry of Agriculture economic publication for all land preparation practices and production articles and tools. Also, prices of main products were taken according to official prices issued by the Ministry of

Agriculture economic publication. (L.E.105/ ton sugarcane and L.E.200/ton tomato according to the prices of 2004). The cost of gated pipes for these experiments was L.E. 1200/ faddan

RESULTS AND DISCUSSION

1- Effect of surface irrigation systems on sugar cane.

Data presented in Table (2) and Fig (1) showed that characters under study of sugar cane were significantly affected by surface irrigation systems in the two seasons. Values of stalk height, stalk diameter, number of millable stalks / fed, cane yield / fed, and W.U.E. were increased by using gated pipes irrigation. The cane yields were increased by 13.55 and 12.05% in the seasons 2003/2004 and 2004/2005 seasons respectively. While the water applied m^3/fed were reduced by 13.94 and 14.85% also the W.U.E. were increased by 25.33 and 24.93% in the same seasons respectively. From Data presented in Table (2) it is clear that the T.S.S. and sucrose percentage were unaffected by using gated pipes, whereas it increased sugar yield/fed.

Table (2): Effect of surface irrigation systems on yield, yield components, Juice quality and yield of sugar cane in 2002/2003 and 2003/2004seasons.

Treatments	Stalk height cm	Stalk diameter cm	No. of millable stalks 1000/fed	T.S.S. %	Sucrose %	Water applied m^3/fed	Cane yield ton/fed	W.U.E. kg/m^3	Sugar yield ton/fed
2003 / 2004									
gated pipes system	264.56	2.61	33.49	20.14	18.15	7052.22	51.47	7.38	5.65
Traditional surface irrigation	258.33	2.56	32.06	19.93	17.95	8195.00	45.24	5.51	4.86
L.S.D. at 0.05	2.14	0.03	0.84	N.S	N.S	19.51	0.49	0.08	0.15
2004 / 2005									
gated pipes system	263.00	2.59	32.97	19.36	18.09	6971.11	49.95	7.22	5.26
Traditional surface irrigation	256.67	2.55	31.83	19.70	17.99	8186.67	44.42	5.42	4.79
L.S.D. at 0.05	3.87	0.04	0.69	0.23	N.S	31.08	0.46	0.46	0.14

2- Effect of intercropping on sugar cane.

Data presented in table (3) and Fig (2) showed that characters under study of sugar cane were significantly affected by intercropping patterns in both seasons. Values of stalk height, stalk diameter, number of millable stalks / fed, cane yield / fed were reduced by intercropped tomato. The reduction was grater when intercropped by two rows of tomato while the reduction was low when intercropped with one row of tomato. The cane yield / fed were reduced by 6.37, 13.52% and 7.48 and 15.98% from pure stand for one row and two rows tomato in the two seasons respectively. Also the W.U.E. had the same trend it was reduced by 7.98, 16.67% and 9.5, 18.53% from pure stand for one row and two rows tomato in the two seasons respectively. There was no relevance between T.S.S. and sucrose percentage and intercropping patterns. Sugar yield / fed of the pure stand surpassed that of intercropped by one or two rows of tomato. These results hold true in both seasons.

Table (3): Effect of intercropping tomato with sugar cane on yield, yield components, juice quality and yield of sugar of sugar cane in 2002/2003 and 2003/2004seasons.

Treatments	Stalk height cm	Stalk diameter cm	No. of millable stalks 1000/fed	T.S.S. %	Sucrose %	Water applied m^3/fed	Cane yield ton/fed	W.U.E. kg/m^3	Sugar yield ton/fed
2003 / 2004									
Sugar cane + one row tomato	264	2.59	32.33	19.96	18.11	7665.83	48.54	6.46	5.19
Sugarcane +two rows tomato	254	2.54	31.33	19.96	17.93	7737.50	44.83	5.85	4.88
Pure stand sugarcane	266	2.63	34.57	20.19	18.11	7467.50	51.84	7.02	5.70
L.S.D. at 0.05	3.42	0.04	0.47	N.S	N.S	35.80	0.25	0.06	0.13
2004 / 2005									
Sugar cane + one row tomato	261.50	2.57	31.73	19.43	18.08	7667.50	47.36	6.33	5.01
Sugarcane +two rows tomato	253.17	2.53	31.28	19.23	17.99	7640.00	43.01	5.67	4.54
Pure stand sugarcane	264.83	2.62	34.18	19.33	18.03	7429.17	51.19	6.96	5.54
L.S.D. at 0.05	3.87	0.04	0.24	0.21	N.S	53.26	0.29	0.06	0.10

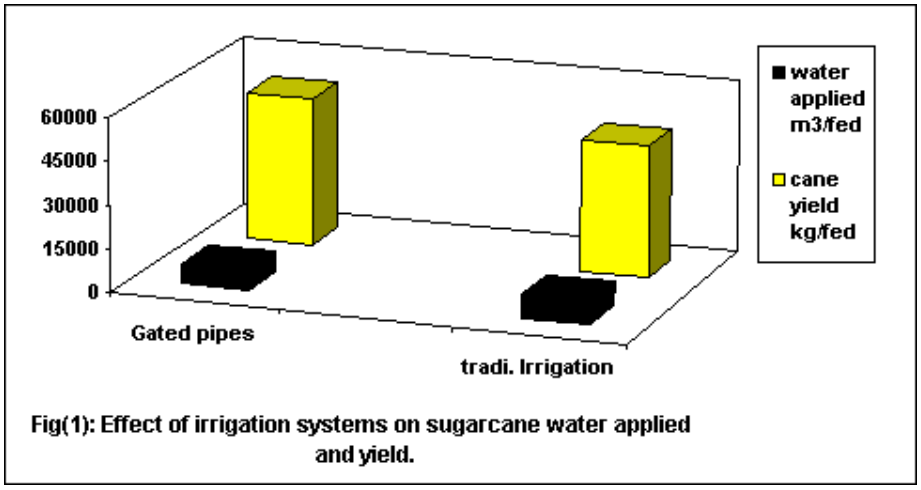
3- Interaction effect of irrigation systems and intercropping patterns on sugar cane.

The interaction effect of irrigation systems and intercropping patterns on characters under study of sugar cane are presented in table (4). Data indicated that the characters under study of sugarcane were affected by using gated pipes system and intercropping tomato with sugarcane. Values of stalk height, stalk diameter, number of millable stalks/fed, T.S.S. % and sucrose % were higher than the same characters which in pure stand sugarcane in traditional surface irrigation. The cane yield was 52.67, 47.38 ton/fed and 51.27, 43.36 ton/fed when one row and two rows of tomato were intercropped with sugarcane in gated pipes system in the two seasons respectively, compared with 48.38 and 47.15 ton/fed for pure stand sugarcane in traditional surface irrigation in the two seasons, respectively. The water applied m^3/fed was reduced by intercropping tomato with sugarcane under irrigation systems. It was 7115, 7226.67 m^3/fed and 7065, 7073.33 m^3/fed when one row and two rows of tomato were intercropped with sugarcane in the two seasons, respectively compared with 8120, 8083.33 m^3/fed for pure stand sugarcane under traditional surface irrigation in the two seasons, respectively. The WUE for sugarcane under gated pipes system and intercropped with tomato was higher than the WUE for pure stand sugarcane under traditional irrigation. It was 7.42, 6.45 kg/m^3 and 7.37, 6.15kg/m^3 when one row and two rows of tomato were intercropped with sugarcane in irrigation system in the two seasons, respectively compared with 5.77 and 5.78 kg/m^3 for pure stand sugarcane under traditional surface irrigation in the two seasons, respectively.

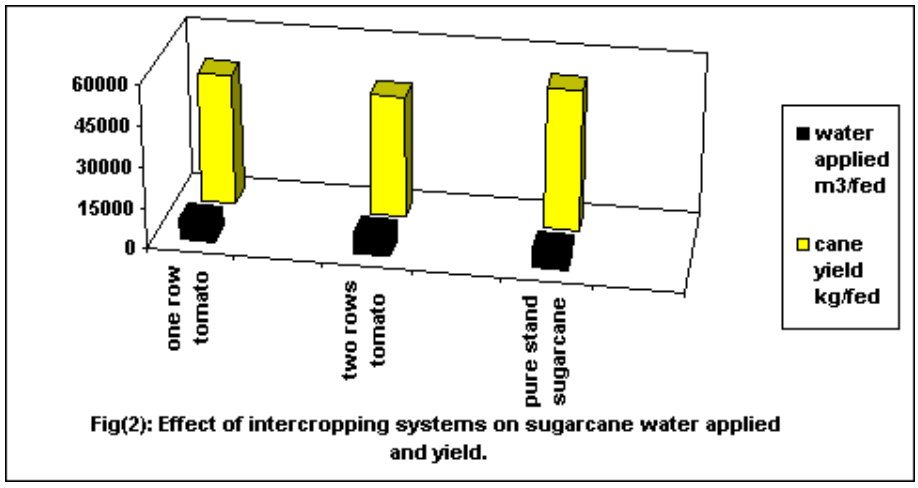
4- Effect of surface irrigation systems on tomato.

Agronomic traits under study as well as fruits damage and marketable yield are statically analyzed and presented in table (5) and Fig (3). Data showed that plant height, No. of fruits/ plant, weight of fruits (kg)/plant, fruits damage %, total fruits yield (ton/fed) and marketable

yield (ton/fed) were improved by using gated pipes. Fruits damage decreased by 2.12 and 1.99% in two seasons respectively.



Fig(1): Effect of irrigation systems on sugarcane water applied and yield.



Fig(2): Effect of intercropping systems on sugarcane water applied and yield.

Table (4): Interaction effect of irrigation systems and intercropping patterns on yield, yield components and juice quality of sugar cane which intercropped with tomato in 2002/2003 and 2003/2004 seasons.

Irrigation systems	Intercropping patterns	2003 / 2004								
		Stalk height cm	Stalk diameter cm	NO. Of millable stalk 1000/fed	T.S.S %	Sucrose %	Water applied m^3/fed	Cane yield ton/fed	W.U.E. kg/m^3	Sugar yield ton/fed
gated pipes system	Sugar cane + one row tomato	267.67	2.62	32.77	20.11	18.25	7115.00	52.67	7.42	5.65
	Sugar cane +two rows tomato	254.00	2.56	31.97	20.23	18.11	7226.67	47.32	6.45	5.11
	Pure stand sugarcane	272.00	2.66	35.57	20.37	18.22	6815.00	56.33	8.26	6.19
	Mean	264.56	2.61	33.44	20.14	18.15	7052.22	51.37	7.38	5.65
Traditional surface irrigation	Sugar cane + one row tomato	260.00	2.55	31.90	20.10	17.97	8216.67	45.12	5.50	4.72
	Sugar cane + two rows tomato	254.00	2.52	30.70	19.68	17.87	8248.33	43.24	5.25	4.64
	Pure stand sugarcane	261.00	2.60	33.57	20.01	18.00	8120.00	48.38	5.77	5.22
	Mean	258.33	2.56	32.06	19.93	17.95	8195.00	45.24	5.51	4.86
L.S.D. at 0.05		1.62	N.S	N.S	N.S	N.S	50.63	0.357	0.077	0.18
		2004 / 2005								
gated pipes system	Sugar cane + one row tomato	265.33	2.60	32.13	19.08	18.10	7065.00	51.27	7.37	5.39
	Sugar cane +two rows tomato	253.67	2.52	31.73	19.03	18.04	7073.33	43.36	6.15	4.48
	Pure stand sugarcane	270.00	2.64	35.03	19.97	18.12	6775.00	55.23	8.14	5.92
	Mean	263.00	2.59	32.96	19.36	18.09	6971.11	49.95	7.22	5.26
Traditional surface irrigation	Sugar cane + one row tomato	257.67	2.54	31.33	19.77	18.07	8270.00	43.46	5.29	4.63
	Sugar cane +two rows tomato	252.67	2.53	30.82	19.43	17.95	8206.67	42.66	5.18	4.60
	Pure stand sugarcane	259.67	2.59	31.33	19.00	17.95	8083.33	47.15	5.78	5.15
	Mean	256.67	2.55	31.83	19.70	17.99	8186.67	44.42	5.42	4.79
L.S.D. at 0.05		N.S	0.55	0.34	0.29	N.S	75.32	0.415	0.077	0.144

Table (5): Effect of irrigation systems on yield and yield components of Tomato in 2002/2003 and 2003/2004seasons.

Treatments	2003 / 2004			2004 / 2005		
	gated pipes system	Traditional surface irrigation	L. S. D. at 0.05	gated pipes system	Traditional surface irrigation	L. S. D. at 0.05
Plant height cm	62.31	60.16	1.34	59.54	57.53	1.59
No. of fruits/plant	40.81	38.31	1.67	39.49	38.31	N.S
Weight of fruits kg/plant	5.75	5.50	N.S	5.44	5.26	N.S
Fruit damage %	11.64	11.79	0.11	12.10	12.02	0.109
Total fruits yield ton/fed	28.88	25.68	0.481	27.81	24.11	0.713
Marketable yield Ton/fed	23.26	24.01	0.988	23.08	21.36	1.506
Water applied m3/fed	6277.78	6646.67	75.02	6347.78	6676.67	58.75
WUE kg/m^3	7.01	6.15	0.189	6.55	4.95	N.S

5- Effect of intercropping on tomato

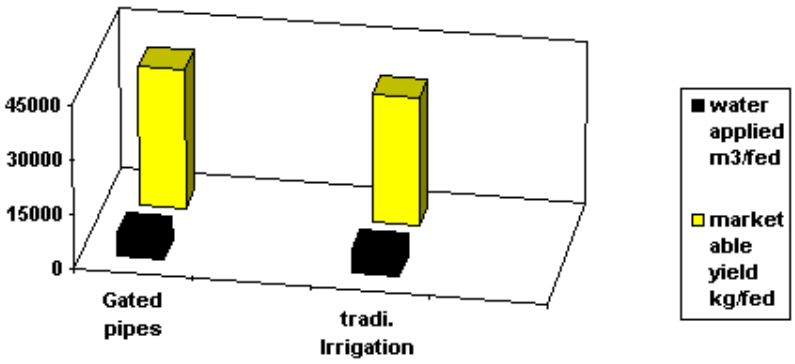
Intercropping tomato with sugarcane protect the tomato fruits from direct effect of sunrays and high temperature. This effect is important for collecting tomatoes with less damage and increasing marketable yield. Data in table (6) and Fig (4) showed that fruit damage decreased by 10.33 and 3.66 %, 13.50 and 2.43% when one row and two rows of tomato were intercropped with sugarcane as compared with sole tomato in the two seasons respectively.

Table (6): Effect of intercropping tomato with sugar cane on yield and yield components of tomato in 2002/2003 and 2003/2004seasons.

Treatments	2003 / 2004				2004 / 2005			
	Sugar cane + one row tomato	Sugar cane + two rows tomato	Solid Tomato	L. S. D. at 0.05	Sugar cane + one row tomato	Sugar cane + two rows tomato	Solid Tomato	L. S. D. at 0.05
Plant height cm	61.73	58.40	63.57	2.55	58.29	56.68	60.50	2.04
No. of fruits/plant	39.38	38.27	41.03	0.96	38.71	37.74	40.24	1.17
Weight of fruits kg/plant	5.71	5.17	6.00	0.44	5.15	4.95	5.95	0.30
Fruit damage %	11.02	11.84	12.29	0.35	11.02	12.43	12.74	0.42
Total fruit yield ton/fed	24.56	25.24	26.28	0.94	24.08	25.08	28.71	0.71
Marketable yield Ton/fed	21.82	23.01	26.08	0.94	20.71	21.88	24.08	0.73
Water applied m^3/fed	8027.50	8171.67	3187.50	69.77	8008.33	8203.33	3325.00	49.06
WUE kg/m^3	3.86	4.07	11.81	0.38	3.81	3.98	9.47	2.75

6- Effect of interaction of irrigation systems and intercropping on tomato.

The effect of interaction of irrigation systems and intercropping on the agronomic traits as well as fruit damage and marketable yield, also water applied and WUE are statistically analyzed and presented in table (7). Tomato plant height, No. of fruits / plant and weight of fruits kg / plant were not affected by the interaction between irrigation systems and intercropping pattern except in the case of weight of fruits kg / plant in the second season. Data show that the fruits damage % was affected by irrigation systems and intercropping, it was 10.97, 11.48 and 12.48% and 11.07, 12.20 and 12.10% for one row, two rows and sole tomato in the two seasons respectively. Marketable yield ton/fed followed the same trend. It were increased by using irrigation systems and intercropping, it was increased in the two seasons compared with solo tomato in the traditional irrigation. It was 23.16 and 24.95 ton/fed and 22.38 and 22.64 ton/fed for row and two rows tomato in the two seasons respectively compared with 25.98 and 23.95 ton/ fed for solo tomato in the traditional irrigation in two seasons respectively.



Fig(3): Effect of irrigation systems on tomato water applied and marketable yield.

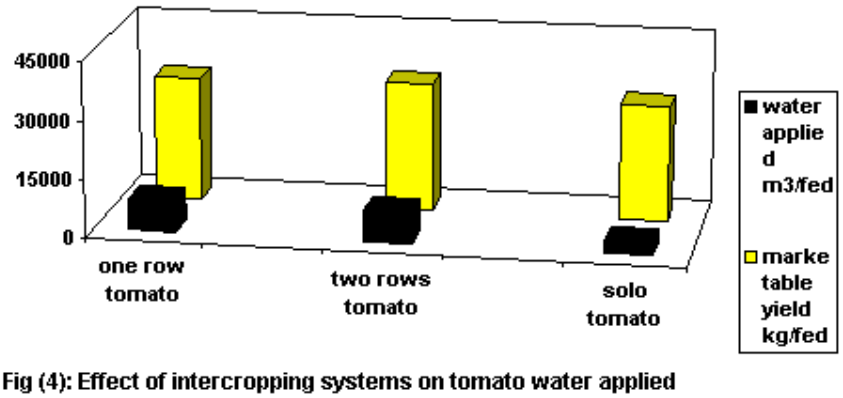


Fig (4): Effect of intercropping systems on tomato water applied and yield.

Table (7): Interaction effect of irrigation systems and intercropping patterns on yield and yield components of tomato intercropped with sugarcane in 2002/2003 and 2003/2004 seasons.

Irrigation systems	Intercropping patterns	2003 / 2004							
		Plant height cm	No. of f./plant	Weight of f. Kg/p.	f. damage %	Mark. Yield ton/fed	Total f. yield ton/fed	Water applied m^3/fed	WUE kg/m3
gated pipes system	Sugar cane + one row tomato	62.67	40.70	5.90	10.97	23.16	26.18	7813.33	4.18
	Sugar cane + two rows tomato	59.10	39.50	5.23	11.48	24.95	26.90	8076.67	4.43
	Solid tomato	65.15	42.23	6.13	12.48	22.90	27.83	2943.33	12.41
	Mean	62.31	40.81	5.75	11.64	23.76	26.97	6277.78	7.01
Traditional surface irrigation	Sugar cane + one row tomato	60.80	38.07	5.51	11.07	20.49	22.93	8241.67	3.54
	Sugar cane + two rows tomato	57.70	37.03	5.12	12.20	21.08	23.57	8266.67	3.70
	Solid tomato	61.98	39.82	5.87	12.10	22.46	25.53	3431.67	11.20
	Mean	60.16	38.31	5.50	11.79	22.50	25.68	6646.67	6.15
L.S.D. at 0.05		N.S	N.S	N.S	0.49	1.33	1.33	98.67	N.S
	2004 / 2005								
gated pipes system	Sugar cane + one row tomato	59.17	39.35	5.28	10.90	22.38	26.40	7736.67	4.13
	Sugar cane +two rows tomato	57.67	38.45	5.00	12.40	22.64	27.00	8166.67	4.19
	Solid tomato	61.80	40.67	6.03	13.00	24.21	30.03	3140.00	11.33
	Mean	59.55	39.49	5.44	12.10	23.08	27.81	6347.78	6.55
Traditional surface irrigation	Sugar cane + one row tomato	57.42	38.07	5.02	11.13	19.04	21.77	8280.00	3.48
	Sugar cane +two rows tomato	55.68	37.03	4.90	12.45	21.11	23.17	8240.00	3.76
	Solid tomato	59.50	39.82	5.87	12.48	23.95	27.38	3510.00	7.60
	Mean	57.53	38.31	5.26	12.02	21.37	24.11	6676.67	4.95
L.S.D. at 0.05		N.S	N.S	0.49	N.S	1.03	0.999	69.38	N.S

7- Interaction effect of irrigation systems and intercropping systems on LER and total income for sugarcane and tomato crops.

Data of LER values in Table (8) indicated that intercropping resulted in more yields advantage in both intercrop combinations compared with growing both crops in monoculture. Results also indicated that the highest LER values were obtained when sugarcane intercropped with two rows tomato while one row of tomato possessed the lowest value.

The LER values were 1.81 and 1.72 when one row of tomato intercropped with sugarcane was irrigated by gated pipes and traditional irrigation systems respectively but when the two rows of tomato intercropped with sugarcane the LER values were 1.87 and 1.75 when irrigated by gated pipes and traditional irrigation respectively. From these data it is clear that intercropping sugarcane with two rows tomato has the advantage from one row tomato. The data also indicated that the sugarcane intercropped with one row tomato under gated pipes gave the highest total income (10663.35 L.E.) while the sugar cane intercropped with two rows tomato under traditional irrigation gave the lowest total income (9113.30 L.E.) also the sugarcane intercropped with two rows tomato gave (1037.28 L.E.) under gated pipes system while the sugarcane intercropped with one rows tomato under traditional irrigation gave (8917.30 L.E.)

Table (8): Interaction effect of irrigation systems and intercropping patterns on LER and total income.

Irrigation systems	Intercropping patterns	Yield of cane ton/fed	Yield of tomato ton/fed	LER	Income of cane LE/fed	Income of tomato LE/fed	Cost of gated pipes L.E./fed	Total income LE/fed
gated pipes system	Pure stand sugarcane	55.23	----------	-------	----------	--------	1200	5799.15
	Sugarcane +one row tomato	51.27	26.40	1.81	5799.15	5280.00	1200	10663.35
	Sugar cane +two rows tomato	43.36	27.00	1.87	5383.35	5400.00	1200	1037.28
	Solid tomato	---------	30.03	----------	4972.80	6006.00	1200	6006.00
Traditional surface irrigation	Pure stand sugarcane	47.15	----------	----------	----------	-------	---------	4950.75
	Sugarcane +one row tomato	43.46	21.77	1.72	4950.75	4354.00	-------	8917.30
	Sugar cane +two rows tomato	42.66	23.17	1.75	4563.30	4634.00	------	9113.30
	Solid tomato	----------	27.38	----------	4479.30	5476.00	---------	5476.00

CONCLUSION

1- Values of stalk height, stalk diameter, number of millable stalks / fed, cane yield /fed, and W.U.E. were increased by using gated pipes irrigation. The cane yields were increased by 11.93 and 11.07% in the two seasons respectively. While the water applied m^3/fed were reduced by 13.94 and 14.85% also the W.U.E. were increased by 25.33 and 24.93% in the same seasons respectively.

2- The cane yield intercropped with tomato were reduced by 6.37, 13.52% and 7.48 and 15.98% less than the pure stand of one row and two rows tomato in both seasons respectively.

3- The cane yield were 52.67, 47.32 ton/fed and 51.27, 43.36 ton/fed when intercropped with one row and two rows of tomato in gated pipes system in the two seasons respectively compared with 48.38 and 47.15 ton/fed for pure stand sugarcane in traditional surface irrigation in the two seasons respectively. The water applied m^3/fed was reduced by using intercropping tomato with sugarcane under irrigation system. It was 7115, 7226.67 m^3/fed and 7065, 7073.33 m^3/fed for one row and two rows in the two seasons respectively compared with 8120, 8083.33 m^3/fed for pure stand sugarcane under traditional surface irrigation in the two seasons.

4- The fruits damage % was affected by interaction between gated pipes systems and intercropping it was 10.97, 11.48 and 12.48% and 11.07, 12.20 and 12.10% for one row, two rows and solid tomato in the two seasons respectively. Marketable yield ton/fed followed the same trend. It was increased by using gated pipes systems and intercropping, it was increased in the two seasons compared with solid tomato in the traditional irrigation. It was 23.16 , 24.95 ton/fed and 22.38 , 22.64 ton/fed for one row and two rows tomato in the two seasons respectively compared with 35.98 and 33.95 ton/ fed for solid tomato in the traditional irrigation in two seasons respectively.

5- The LER value for sugarcane intercropped with one row and two rows of tomato were 1.81 and 1.87 respectively for gated pipes system while it was 1.72 and 1.75 for one row and two rows tomato for traditional surface irrigation respectively.

6- The sugarcane intercropped with one row tomato under gated pipes gave the highest total income, (10663.35 L.E.) while the sugar cane intercropped with two rows tomato under traditional irrigation gave the lowest total income, (9113.30 L.E.).

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