

Table 1. Physical parameters of tank to biofilter (treatment) ratios.

Biofilter ratio (v/v)	-----Water : Biofilter -----		No. Plants		Irrigation (liter m ⁻² d ⁻¹)
	(v/v)	(a/a)	(m ⁻²)	(plot ⁻¹)	
1: 0.67	1 : 0.67	1 : 1.00	4.0	4	500
1: 1.00	1 : 1.00	1 : 1.50	4.0	6	500
1: 1.50	1 : 1.50	1 : 2.25	4.0	9	500
1: 2.25	1 : 2.25	1 : 3.38	4.0	14	500

Table 2. Elemental composition of the fish feed input to the system.

Element	N	P	K	Ca	Mg	Cl	S	Fe	Mn	Zn	Cu	B	Mo
	------(%)-----						----- (μg·g ⁻¹) -----						
Fish Feed	4.65	0.88	1.20	1.31	0.28	0.6	1600	201	52	65	12	22	0.4

Table 3. Fish stocking, growth and harvest variables as influenced by tank to biofilter ratio and experiment.

Biofilter ratio (v/v)	Stocking data			Growth data					Harvesting data		
	Pm _i (g)	n (n m ⁻³)	B _i (kg m ⁻³)	G (g d ⁻¹)	MSG (%)	DRIB (%)	Increase (kg/m ³)	FCR 1 :	Pm _f (g)	B _f (kg m ⁻³)	M (kg d ⁻¹)
<i>a) Experiment 1, Laura tomato in the biofilters</i>											
1: 0.67	15.4	75.2	1.11	1.72	385.8	2.52	13.34	1.51	204.5	14.76	3.9
1: 1.00	14.3	77.3	1.25	1.98	405.9	2.57	15.74	1.29	227.6	16.82	4.0
1: 1.50	14.5	76.2	1.11	1.86	420.4	2.61	14.58	1.40	216.4	15.66	4.1
1: 2.25	15.1	78.2	1.09	1.99	469.3	2.71	16.03	1.27	217.3	16.73	4.2
LSD (P= 0.05)	NS	NS	NS	0.21	NS	NS	2.35	NS	NS	1.95	0.1
<i>b) Experiment 2, No crop interval and Fidello cucumber in the biofilters</i>											
1: 0.67	163.8	21.5	3.93	1.90	55.7	0.67	5.21	2.60	453.6	9.14	1.1
1: 1.00	162.4	24.3	3.90	1.89	59.6	0.71	5.79	2.09	406.7	9.69	1.1
1: 1.50	158.3	25.2	3.87	2.33	69.8	0.84	7.41	1.95	464.5	11.29	1.1
1: 2.25	161.1	23.5	3.87	2.41	68.7	0.83	7.22	2.03	452.3	11.08	1.1
LSD (P= 0.05)	NS	NS	NS	0.49	10.5	0.13	1.65	0.41	NS	1.62	0.1
<i>c) Experiment 3, Kewalo tomato in the biofilters</i>											
1: 0.67	440.0	20.5	8.80	1.80	35.8	0.33	5.16	2.83	652.0	13.67	1.1
1: 1.00	421.4	20.1	8.83	1.93	36.4	0.35	5.57	2.59	715.7	13.93	1.1
1: 1.50	438.0	19.6	8.72	1.99	36.6	0.35	5.35	2.74	711.2	13.85	1.1
1: 2.25	438.3	20.4	8.55	2.06	38.1	0.38	5.16	2.87	689.2	14.10	1.1
LSD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	55.4	NS	1.1

Pm_i : mean individual weight at stocking

n : number of fish

B_i : mean biomass at stocking

G: average growth rate of individual fish during the culture period

MSG : average monthly specific growth rate

DRIB : daily rate of increase of the biomass calculated from $B_f = B_i (1 + i)^n$ where n= interval in days and $i = (DRIB/100)$

FCR : Feed conversion ratio

Pm_f : mean weight at harvest

B_f : mean biomass at harvest

MP : average monthly production: $(B_f - B_i)$ observed and recalculated on a 30.4-day basis)

NS : Nonsignificant

Table 4. Water quality and amendments as influenced by tank to biofilter ratio and experiment.

Biofilter ratio (v/v)	Water Quality						Water Amendments			
	DO	Temp.	TAN	NO ₂ ⁻	NO ₃ ⁻	pH	HOH added		pH Adjustment	
	(mg l ⁻¹)	(°C)	(mg l ⁻¹)	(mg l ⁻¹)	(mg l ⁻¹)		(liters)	(l m ⁻²)	lime (g)	CaO (g)
<i>a) Experiment 1, Laura tomato in the biofilters</i>										
1: 0.67	6.03	28.4	9.01	1.24	-	6.18	861	861	0	0
1: 1.00	6.15	28.4	7.70	0.99	-	5.95	1093	729	0	0
1: 1.50	6.36	28.1	5.78	0.87	-	5.95	1244	553	0	0
1: 2.25	6.47	27.5	3.65	0.64	-	5.84	1727	512	0	0
LSD (<i>P</i> = 0.05)	0.28	0.8	0.73	0.21	-	0.23	189	84	NS	NS
<i>b) Experiment 2, No crop interval and Fidello cucumber in the biofilters</i>										
1: 0.67	-	26.9	-	-	-	5.32	1268	1268	2000	12.5
1: 1.00	-	26.9	-	-	-	5.06	1356	904	2000	23.8
1: 1.50	-	26.7	-	-	-	5.33	1501	667	2000	18.8
1: 2.25	-	25.6	-	-	-	6.00	2328	690	2000	0.0
LSD (<i>P</i> = 0.05)	-	NS	-	-	-	0.45	217	112	NS	16.4
<i>c) Experiment 3, Kewalo tomato in the biofilters</i>										
1: 0.67	5.43	29.0	0.96	0.20	229	6.33	1686	1686	0	265
1: 1.00	5.79	28.9	0.79	0.17	237	6.29	1836	1224	0	324
1: 1.50	5.91	28.2	0.61	0.14	207	6.35	2262	1005	0	221
1: 2.25	6.10	27.8	0.48	0.06	92	6.52	3115	923	0	51
LSD (<i>P</i> = 0.05)	0.42	NS	0.33	0.04	72	0.14	137	78	NS	150

DO : dissolved oxygen

TAN : total ammoniacal nitrogen

lime : CaMg(CO₃)₂

CaO : Calcium oxide

NS : Nonsignificant

Table 5. Fish growth during the 362 day interval with 'Laura' tomato, no crop, 'Fidello' cucumber and 'Kewalo' tomato as influenced by tank to biofilter ratio.

Biofilter ratio (v/v)	Composite Growth Rates				Composite Production Ratios	
	G (g d ⁻¹)	MSG (%)	DRIB (%)	Increase (kg m ⁻³)	Fish increase (kg plant ⁻¹)	Fruit yield / fish increase (kg kg ⁻¹ fish increase)
1: 0.67	1.80	148.4	1.08	23.71	2.96	3.82
1: 1.00	1.93	154.8	1.11	27.10	2.26	3.27
1: 1.50	2.07	162.2	1.18	27.38	1.52	4.51
1: 2.25	2.16	176.5	1.22	28.41	1.02	6.92
LSD (<i>P</i> = 0.05)	NS	NS	NS	3.12	0.28	1.32

G : average growth rate of individual fish during the culture period

MSG : average monthly specific growth rate

DRIB : daily rate of increase of the biomass calculated from $B_f = B_i (1 + i)^n$ where
n= interval in days and i = (DRIB/100)

NS : Nonsignificant

Table 6. Water quality and total amendments made during the 362 day interval of 'Laura' tomato, no crop, 'Fidello' cucumber and 'Kewalo' tomato as influenced by tank to biofilter ratio.

Biofilter ratio (v/v)	Water Quality						Water Amendments			
	DO (mg l ⁻¹)	Temp. (°C)	NH ₃ (mg l ⁻¹)	NO ₂ ⁻ (mg l ⁻¹)	NO ₃ ⁻ (mg l ⁻¹)	pH	HOH added		pH Adjustment	
							(liters)	(l m ⁻²)	lime (g)	CaO (g)
1: 0.67	5.58	28.7	4.49	0.65	229.0	5.94	3782	3815	2000	265
1: 1.00	5.95	28.7	3.82	0.53	237.0	5.75	4285	2857	2000	324
1: 1.50	6.11	28.1	2.88	0.46	207.0	5.83	5007	2225	2000	221
1: 2.25	6.26	27.7	1.87	0.32	92.0	5.97	7170	2125	2000	51
LSD (<i>P</i> = 0.05)	0.29	1.2	0.50	0.11	72.4	NS	406	165	NS	150

DO : dissolved oxygen

TAN : total ammoniacal nitrogen

lime : CaMg(CO₃)₂

CaO : Calcium oxide

NS : Nonsignificant

Table 7. Comparative tilapia growth rates as influenced by various recirculatory aquaculture systems integrated with plant production.^z

Species Cultured	Sex	Culture Type	Feed Input			Stocking data			Growth data			Harvesting data		
			Protein (%)	Days	FCR 1 :	P _{m_i} (g)	n (m ⁻³)	B _i (kg m ⁻³)	G (g d ⁻¹)	MSG (%)	DRIB (%)	P _{m_f} (g)	B _f (kg m ⁻³)	MP (kg m ⁻³)
<i>S. aureus</i>	male	Recirc., integrated	32	181	1.59	62	17	1.06	2.5	138	1.17	521	8.67	1.28
<i>O. hybrid</i>	male	Recirc., integrated	36	193	2.11	68	41	5.09	2.2	54	0.77	425	22.48	2.74
<i>S. aureus</i>	mixed	Recirc., integrated	36	177	1.71	54	105	5.73	1.6	104	1.02	336	34.73	4.98
<i>O. hybrid</i>	male	Recirc., integrated	36	118	1.90	50	56	3.76	2.2	102	1.36	261	18.61	3.83
<i>O. niloticus</i>	mixed	Recirc., integrated	37	107	1.24	20	127	3.93	0.6	76	1.39	86	10.45	1.85
<i>O. hybrid</i>	male	Recirc., integrated	36	103	2.14	15	74	1.14	2.0	387	2.60	217	16.08	4.41
Mean of 3 other culture systems (above)			35	155	1.51	45	83	3.57	1.6	106	1.19	314	17.95	2.70
Mean of 3 growth intervals from this study			36	138	2.05	44	57	3.33	2.1	181	1.58	301	19.06	3.66

S. : *Sarotherodon* spp.

O. : *Oreochromis* spp.

Recirc.: Closed recirculatory water movement (fish tank to biofilter(s) back to fish tank) with co-cultured vegetable crop(s).

FCR : Feed conversion ratio (FCR = feed input/(B_f-B_i)).

P_{m_i} : mean individual weight at stocking.

n : number of fish.

B_i : mean biomass at stocking.

G : average growth rate of individual fish during the culture period.

MSG : average monthly specific growth rate.

DRIB : daily rate of increase of the biomass calculated from B_f = B_i (1 + i)ⁿ where n= interval in days and i = (DRIB/100).

P_{m_f} : mean individual weight at harvest .

B_f : mean biomass at harvest.

MP : average monthly production: (B_f - B_i) observed and recalculated on a 30.4-day basis).

^z : Values reported herein were calculated from information reported by the respective authors.