

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

Biofilter ratio (v/v)	-----Water : Biofilter -----		No. Plants		Irrigation (liter m <sup>-2</sup> d <sup>-1</sup> )
	(v/v)	(a/a)	(m <sup>-2</sup> )	(plot <sup>-1</sup> )	
1: 0.67	1 : 0.67	1 : 2.00	4.0	4	500
1: 1.00	1 : 1.00	1 : 3.00	4.0	6	500
1: 1.50	1 : 1.50	1 : 4.50	4.0	9	500
1: 2.25	1 : 2.25	1 : 6.75	4.0	14	500

Table 2. 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						Amendments	
	DO	Temp.	NH <sub>3</sub>	NO <sub>2</sub> <sup>-</sup>	NO <sub>3</sub> <sup>-</sup>	pH	pH Adjustment	
	(mg l <sup>-1</sup> )	(°C)	(mg l <sup>-1</sup> )	(mg l <sup>-1</sup> )	(mg l <sup>-1</sup> )		lime (g)	CaO (g)
1: 0.67	5.58	28.7	4.49	0.65	229.0	5.94	2000	265
1: 1.00	5.95	28.7	3.82	0.53	237.0	5.75	2000	324
1: 1.50	6.11	28.1	2.88	0.46	207.0	5.83	2000	221
1: 2.25	6.26	27.7	1.87	0.32	92.0	5.97	2000	51
LSD ( <i>P</i> = 0.05)	0.29	1.2	0.50	0.11	72.4	NS	NS	150

DO : dissolved oxygen  
TAN: total ammoniacal nitrogen  
lime: CaMg(CO<sub>3</sub>)<sub>2</sub>  
CaO: Calcium oxide  
NS : Nonsignificant

Table 3. Elemental composition of the fish feed input to the system.

Element	N	P	K	Ca	Mg	Cl	S	Fe	Mn	Zn	Cu	B	Mo
	------(%)-----						-----( $\mu\text{g}\cdot\text{g}^{-1}$ )-----						
Fish Feed	4.65	0.88	1.20	1.31	0.28	0.6	1600	201	52	65	12	22	0.4

Table 4. Fish stocking data, daily feed input rates, feed conversion ratios, and harvest data as influenced by tank to biofilter ratio and experiment for each of three experiments.

Biofilter ratio (v/v)	Stocking data			Feed input rate			Harvesting data		
	P <sub>m<sub>i</sub></sub> (g)	n (n m <sup>-3</sup> )	B <sub>i</sub> (kg m <sup>-3</sup> )	per day (%P <sub>m<sub>i</sub></sub> )	per day (%P <sub>m<sub>f</sub></sub> )	FCR 1 :	P <sub>m<sub>f</sub></sub> (g)	B <sub>f</sub> (kg m <sup>-3</sup> )	MP (kg m <sup>-3</sup> )
<i>a) Experiment 1, Laura tomato in the biofilters</i>									
1: 0.67	15.4	75.2	1.11	9.47	2.01	1.51	204.5	14.76	3.94
1: 1.00	14.3	77.3	1.25	8.75	1.80	1.29	227.6	16.82	4.65
1: 1.50	14.5	76.2	1.11	9.41	1.91	1.40	216.4	15.66	4.32
1: 2.25	15.1	78.2	1.09	9.72	1.81	1.27	217.3	16.73	4.74
LSD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	1.95	0.70
<i>b) Experiment 2, no crop interval and Fidello cucumber in the biofilters</i>									
1: 0.67	163.8	21.5	3.93	1.75	1.07	2.60	453.6	9.14	1.25
1: 1.00	162.4	24.3	3.90	1.67	1.00	2.09	406.7	9.69	1.39
1: 1.50	158.3	25.2	3.87	1.79	0.95	1.95	464.5	11.29	1.77
1: 2.25	161.1	23.5	3.87	1.75	0.97	2.03	452.3	11.08	1.73
LSD (P= 0.05)	NS	NS	NS	NS	NS	0.41	NS	1.62	0.39
<i>c) Experiment 3, Kewalo tomato in the biofilters</i>									
1: 0.67	440.0	20.5	8.80	1.64	0.56	2.83	652.0	13.67	1.19
1: 1.00	421.4	20.1	8.83	1.66	0.54	2.59	715.7	13.93	1.28
1: 1.50	438.0	19.6	8.72	1.70	0.55	2.74	711.2	13.85	1.23
1: 2.25	438.3	20.4	8.55	1.70	0.55	2.87	689.2	14.10	1.19
LSD (P= 0.05)	NS	NS	NS	NS	NS	NS	55.4	NS	NS

P<sub>m<sub>i</sub></sub> : mean individual weight at stocking

n : number of fish

B<sub>i</sub> : mean biomass at stocking

FCR: Feed conversion ratio

P<sub>m<sub>f</sub></sub> : mean weight at harvest

B<sub>f</sub> : mean biomass at harvest

MP: average monthly production: (B<sub>f</sub> - B<sub>i</sub>) observed and recalculated on a 30.4-day basis)

NS: Nonsignificant

Table 5. Influence of tank to biofilter ratio on total water consumption, number of fish tank exchanges, total crop irrigations, number of water use applications, and yield of fish and fruit per liter of water used in the continuous operation of a recirculatory aquaculture-olericulture system for each of three experiments.

Tank to biofilter ratio (v/v)	Total water used (liters/plot)	Fish tank exchanges	Total crop irrigations	Water use applications <sup>Z</sup>	Yield per liter of water used		Water pH
					Fish (g/l)	Fruit (g/l)	
<i>a) Experiment 1, 'Laura' tomato</i>							
1:0.67	644	103	824	160	10.4	21.4	6.17
1:1.00	963	155	824	161	8.2	17.7	5.93
1:1.50	1201	232	824	193	6.1	18.2	5.93
1:2.25	1560	348	824	223	5.1	20.2	5.82
LSD ( $P= 0.05$ )	77	-	-	16	1.9	NS	0.13
<i>b) Experiment 2, 'Fidello' cucumber</i>							
1:0.67	533	85	680	160	2.7	20.9	5.23
1:1.00	556	128	680	230	3.8	9.7	4.97
1:1.50	669	191	680	285	3.4	15.2	5.22
1:2.25	860	287	680	334	2.8	38.1	5.84
LSD ( $P= 0.05$ )	195	-	-	74	NS	13.7	0.47
<i>c) Experiment 3, 'Kewalo' tomato</i>							
1:0.67	1248	132	1056	106	2.1	16.0	6.33
1:1.00	1657	198	1056	120	1.7	13.2	6.29
1:1.50	2132	297	1056	139	1.3	12.8	6.35
1:2.25	2843	446	1056	157	0.9	11.6	6.52
LSD ( $P= 0.05$ )	110	-	-	7	0.3	NS	0.14

<sup>Z</sup> The average number of times each liter of water was reused for fish and fruit production.

NS: Nonsignificant.

Table 6. Influence of tank to biofilter ratio on the edible output of fish and fruit produced in a recirculatory aquaculture-olericulture system expressed as caloric value and protein produced per liter of water used and as the total caloric and protein production for each of three experiments.

Tank to Biofilter ratio (v/v)	calories (cal.) produced per liter of water used			Protein (DW) produced per liter of water used			Total production of	
	Fish	Fruit	Total	Fish	Fruit	Total	calories (cal.)	Protein (DW g)
<i>a) Experiment 1, 'Laura' tomato</i>								
1:0.67	7.47	3.21	10.68	0.92	0.16	1.08	6,864	691
1:1.00	5.88	3.67	9.55	0.72	0.18	0.91	9,178	870
1:1.50	4.37	3.94	8.31	0.54	0.20	0.73	9,986	881
1:2.25	3.68	4.25	7.93	0.45	0.21	0.66	12,386	1,038
LSD ( $P= 0.05$ )	1.31	0.70	1.05	0.16	0.04	0.14	1,093	99
<i>b) Experiment 2, 'Fidello' cucumber</i>								
1:0.67	1.91	3.13	5.05	0.23	0.23	0.46	2,700	249
1:1.00	2.70	1.45	4.15	0.33	0.11	0.44	2,164	228
1:1.50	2.46	2.28	4.75	0.30	0.17	0.47	3,277	318
1:2.25	2.02	5.72	7.74	0.25	0.43	0.67	6,731	579
LSD ( $P= 0.05$ )	NS	2.05	2.13	NS	0.15	0.18	1,859	140
<i>c) Experiment 3, 'Kewalo' tomato</i>								
1:0.67	1.48	3.52	5.00	0.18	0.18	0.36	6,230	446
1:1.00	1.21	2.91	4.12	0.15	0.15	0.29	6,848	488
1:1.50	0.90	2.82	3.72	0.11	0.14	0.25	7,930	536
1:2.25	0.65	2.55	3.20	0.08	0.13	0.21	9,133	591
LSD ( $P= 0.05$ )	0.23	NS	0.66	0.03	NS	0.03	2,046	NS

NS : Nonsignificant.

Table 7. Influence of tank to biofilter ratio on projected yearly fish yield per cubic meter of tank for two market sizes, yield for three crops of tomato per square meter of biofilter, and market value of fish and fruit produced per square meter of biofilter per year in the continuous operation of a recirculatory aquaculture-olericulture system.

Tank to biofilter ratio (v/v)	<u>Projected yearly fish yeild</u>		<u>Yield of three tomato crops of</u>		<u>Market value of 442g fish</u>	
	if fish 214g (kg/m <sup>3</sup> /yr)	if fish 442g (kg/m <sup>3</sup> /yr)	'Laura' (kg/m <sup>2</sup> /yr)	'Kewalo' (kg/m <sup>2</sup> /yr)	with 'Laura' (US\$/m <sup>2</sup> /yr)	with 'Kewalo' (US\$/m <sup>2</sup> /yr)
1:0.67	56.3	41.5	81.9	59.8	138.5	113.2
1:1.00	58.2	47.6	68.0	44.1	122.1	91.5
1:1.50	59.1	49.3	58.5	36.5	108.6	77.7
1:2.25	63.9	53.8	56.3	29.4	103.6	63.7
LSD ( <i>P</i> = 0.05)	5.2	7.3	10.4	11.0	13.5	14.2