Murdoch UNIVERSITY

HYDROPONICS AS A METHOD TO REUSE AND TREAT WASTEWATER FROM DECENTRALISED TREATMENT SYSTEMS

Outline

- Introduction
- Materials & methods
- Results
- Discussion
- Conclusion

Introduction

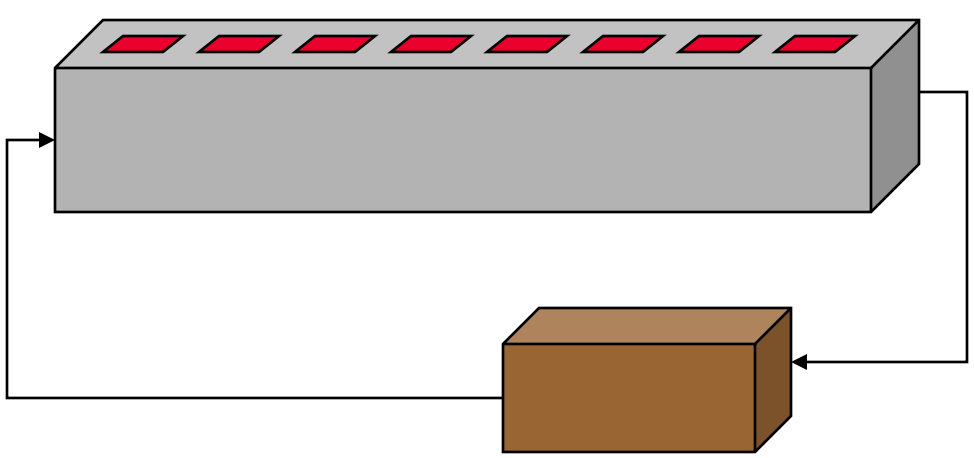
- Environmental sustainability by 2015.
- Change from forestry to agriculture ~ 13 million ha/year.
- Sustainable farming & sanitation practices required.
- Wastewater hydroponics can be used.

Introduction

- Use secondary treated wastewater as the nutrient source.

- Successful crop production depends on
  - Nutrient solution (wastewater) retention time
  - Amount of nutrients in wastewater

Materials & methods



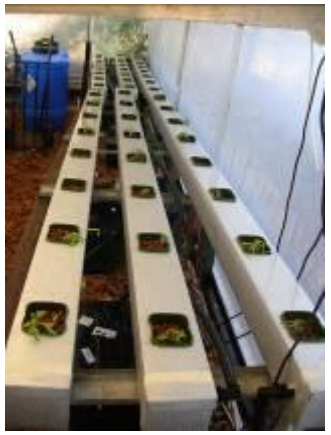


Figure 1: NFT experiment set up

Materials & methods

- WW & CM treatments
- Grew plants with 2 NSRTs
  - Silver beet (varied & 14-day)
  - Tomatoes (varied & 14-day)

- Nitrate, ammonium, phosphate, pH, EC & DO measured every 14 days.
- Total nitrogen & phosphorus measured in edible parts of plant.

Results

Table 1: Water balance

	Varied NSRT				14-day NSRT			
	Silver beet (56 days)		Tomatoes (98 days)		Silver beet (56 days)		Tomatoes (98 days)	
	WW	CM	WW	CM	WW	CM	WW	CM
Influent (L)	240	240	480	480	480	480	840	840
Effluent (L)	30	30	60	60	150	150	225	225
Loss (L)	210	210	420	420	330	330	615	615
% Loss	87.5	87.5	87.5	87.5	68.8	68.8	73.2	73.2

Results

Table 2: Nutrient balance in solution

	Nutrient (mg)	Varied NSRT				14-day NSRT			
		Silver beet		Tomatoes		Silver beet		Tomatoes	
		WW	CM	WW	CM	WW	CM	WW	CM
Influent	NO_3^-	275	8144	1098	32576	1098	32576	3363	99764
	NH_4^+	6227	1600	24909	6400	24909	6400	76283	19600
	PO_4^{3-}	680	1760	2720	7040	2720	7040	8330	21560
Effluent	NO_3^-	16.7± 1.7	237.3± 11.9	361.3± 19.6	928± 22.3	700± 37.5	935± 5	2425± 110	3830± 1414
	NH_4^+	2.87± 0.8	2.7± 0.8	14.47± 3.3	9.67± 2.3	120± 5	230± 5.8	592.5± 56.8	725± 28.8
	PO_4^{3-}	14.0± 0.9	95.3± 4.3	35.3± 5.1	111.3± 6.4	146.7± 3.33	698.3± 75	247.5± 19.9	1102.5± 54
Loss	NO_3^-	258.3	7906.7	736.7	31648	398	31632	938.4	95934
	NH_4^+	6224	1597	24894	6390.3	24789	6170	75690	18875
	PO_4^{3-}	665.9	1664.7	2684.7	6928.7	2573.3	6341.7	8082	20457.5

Results

Table 3: Initial & final quality of silver beet solutions

	Wastewater								Control medium							
	Varied NSRT			14-day NSRT					Varied NSRT			14-day NSRT				
	0	**35**	**56**	**0**	**14**	**28**	**42**	**56**	**0**	**35**	**56**	**0**	**14**	**28**	**42**	**56**
pH	7.7	7	7	7.7	6.7	6.7	5.7	4	6.5	6.5	7.2	6.5	6	5.6	4.3	5
EC (mS/cm)	1.5	0.6	0.02	1.5	0.3	0.2	0.3	1.2	2.5	1.3	0.08	2.5	1.4	1.4	1.9	1.8
NO_3^- (mg/L)	1.72	1.3	0.3	2	2.7	4.7	2.8	4.5	51	19	4.2	51	6.2	3.4	4.4	6.4
NH_4^+ (mg/L)	39	0.1	0.05	39	0.5	0.7	0.5	0.9	10	0.2	0.04	10	3.1	0.3	0.9	0.5
PO_4^{3-} (mg/L)	4.3	1.2	0.04	4	0.6	1.4	0.3	0.7	11	7.1	2.4	11	8.4	7.1	0.7	0.5

Results

Table 4: Initial & final quality of tomato solutions

Media	Parameter	Varied NSRT					14-day NSRT							
		0	35	56	81	98	0	14	28	42	56	70	84	98
Wastewater	pH	7.7	6.5	7.5	7.7	7.6	7.7	7	6.7	6.3	5.7	6.7	7	6.9
	EC (mS/cm)	1.5	0.7	0.6	0.6	0.5	1.5	0.3	1.4	0.5	0.5	0.3	0.2	0.2
	NO_3^- (mg/L)	1.7	7.7	1.5	1.8	8.8	2	4.2	3.6	3.1	5.5	5.6	6.8	6
	NH_4^+ (mg/L)	39	0.2	0.03	0.2	0.2	39	0.6	0.4	0.1	0.7	0.9	0.4	0.2
	PO_4^{3-} (mg/L)	4.3	0.9	0.07	0.2	0.2	4	0.4	0.5	0.1	0.6	1.2	0.4	0.2
Control medium	pH	6.5	6.5	7.6	6.5	7.2	6.5	6.2	6.1	5.1	4.1	6.6	6.8	6.6
	EC (mS/cm)	2.5	1.2	1.4	1.5	0.9	2.5	1.5	1.2	2.4	2.7	1.9	1.4	1.3
	NO_3^- (mg/L)	51	16	1.1	16	11.3	51	5.4	3.4	5.3	5.8	6.1	6.5	5.9
	NH_4^+ (mg/L)	10	0.2	0.02	0.4	0.05	10	4.8	0.8	0.6	0.6	0.6	1.7	1
	PO_4^{3-} (mg/L)	11	0.6	0.2	0.7	4.6	11	7.8	2.5	0.8	0.9	0.8	1.2	1

Results

Table 5: Total N & P in edible parts of plant

	Varied NSRT				14-day NSRT			
	Silver beet		Tomatoes		Silver beet		Tomatoes	
	WW	CM	WW	CM	WW	CM	WW	CM
Total N (mg)	24300	182830	25290	77220	53600	56880	22320	79020
P (mg)	3120	24970	4520	19190	7740	9350	5880	16540

Discussion

- Use wastewater to grow crops:
  - Saves water
  - Saves fertiliser use
- Low pH could be due to nitrification
- High EC could be due to evapotranspiration

Discussion

- Nitrogen important nutrient for plant growth.
- More N in 14-day NSRT as more available.
- Effluent can be used for further irrigation.

Conclusion

- This system can be used as a tertiary treatment option.

- Crops are of better quality after grown in the 14-day NSRT than varied NSRT.

- Effluent can be reused for further irrigation.