



NORTH EAST WATER

OVERVIEW

North East Water in conjunction with The University of Melbourne investigated microbial contamination on lettuce grown hydroponically, comparing Class A & B Reclaimed and River water.

A green oak lettuce variety was grown over 6 weeks in a controlled greenhouse environment under uniform conditions. Water quality was monitored throughout and random lettuce samples from all treatments were analysed for contamination.

OBJECTIVES

1. To determine if Class A and B Reclaimed water is safe & within recommended guidelines to use on hydroponically grown lettuce in comparison to River water.
2. To determine differences in growth rate between reclaimed and river water treatments for the commercial sale of hydroponically grown lettuce.

METHOD & MATERIALS

WATER TREATMENT

BNR (Biological Nutrient Removal) Plant
Class A: Sand Filtration and 30min chlorine contact tank (disinfection).
Class B: Clarifiers and UV disinfected.
River: Untreated

SYSTEM: 300 lettuce seedlings (100 per treatment) were transplanted into three separate re-circulating Nutrient Film Technique (NFT) systems, each utilising a different water supply. This system only allows the plant roots to come into contact with the water preventing foliar contamination.

WATER COLLECTION & NUTRIENT ADDITION: Water and nutrients for each treatment were replaced every two weeks. Hydroponic nutrients were added to each water supply to obtain an EC value between 1300-1400µS/cm, the average for hydroponically grown lettuce.

WATER ANALYSIS: Daily water monitoring consisted of pH, EC, temperature and DO. Weekly microbial water quality analysis consisted of *E.coli*, faecal coliforms, plate counts and faecal streptococci.

PRODUCT ANALYSIS: 10% of lettuce produced per treatment were randomly selected and analysed for *E.coli*, faecal coliforms and total aerobic count (TAC). Food contaminants; Salmonella and Listeria. The three systems utilised can be seen in **Figure 2**.



Figure 1: Established lettuce plants and root development

KEY
 pH : Hydrogen and hydroxide ions
 DO: Dissolved Oxygen
 EC: Electrical Conductivity

INVESTIGATING THE MICROBIAL CONTAMINATION OF USING CLASS A & B RECLAIMED WATER AND RIVER WATER ON HYDROPONIC LETTUCE PRODUCTION

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Figure 2. Re-circulating Nutrient Film Technique (NFT) system design and materials.

RESULTS

ADDITIONS	CLASS A	CLASS B	RIVER
Hydroponic Nutrients (ml)	963	975	2140
pH Correction (ml)	12.7	12.8	5.6

Table 1. The average dose rate of hydroponic nutrient and acid for pH correction to 400L of raw water supply. River water required 65% more hydroponic nutrient to achieve the average EC value. Reclaimed water had a higher initial EC value in comparison to river water.

FINAL PLANT MATTER

NOT DETECTED: *E.coli*
Salmonella
Listeria

DETECTED: Total Aerobic Count (TAC)
Faecal coliforms

ANALYSIS	CLASS A	CLASS B	RIVER
Average TAC	73,607	7,315	7,266
Samples Contaminated	100%	100%	100%
Average FC	180.5	42.9	4.5
Samples Contaminated	20%	30%	10%

Table 2. The average TAC and Faecal Coliform contamination detected on final plant produce per treatment. Ten samples per treatment were analysed and the percentage of samples contaminated is shown.

WATER MICROBIAL QUALITY

AVERAGE MICROBIAL WATER RESULTS	CLASS A	CLASS B	RIVER
<i>E.Coli</i>	0.7	14.6	3
Plate Count	163,419	121,517	73,617
Faecal Streptococci	0.5	0.5	2
Faecal Coliforms	3.3	147.3	16.7

Table 3. Average results of microbial contamination for each water treatment throughout the trial.

FINAL PLANT GROWTH



Figure 3. Final lettuce product grown using Class A, Class B and river water.

River water produced larger lettuce due to receiving 65% more nutrient concentrate in comparison to reclaimed water. Class A and B grew to commercial size and did not show any signs of abnormal growth or disease.

CONCLUSION

No *E.coli*, *Salmonella* or *Listeria* were detected on final lettuce produce. Faecal coliforms were detected however the recommended guidelines for irrigation water based on crops for direct human consumption is <1000 faecal coliforms (Anon. 2000) and no more than 20% samples should exceed 4,000 organisms/100ml (Anon. 2000)

Faecal coliforms (used as an indicator organism for the presence of pathogens) were detected and within recommended guidelines. TAC were also detected however this is an overall measurement of aerobic colony contamination, and is not necessarily an indicator of harmful contaminants. Further investigation is required to determine the strain of faecal coliforms and TAC present. The problem associated with reclaimed water is it contains human faeces in comparison to river water which is predominantly contaminated with animal faeces. Concern exists if human pathogens can be transferred by consuming raw food produce in contact with reclaimed water, hence further investigation is necessary.

The high contamination results for Class A were due to two extreme outlying figures in comparison to Class B and river water. These results were unexpected and errors may have occurred during the sampling process.

Overall, none of the water treatments contaminated the final lettuce matter with *E.coli*, *Salmonella* or *Listeria*. Faecal coliforms were detected however they were still within the recommended guidelines. TAC were also detected however their origin is not known.

This trial is the basis for further investigation.

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* Now General Manager of Hortec Dosing Systems