UTILIZATION OF FISH FARMS WATER FOR VEGETABLES PRODUCTION

By

AMIRA ABDEL-NASER MOHAMMED AMIN

B. Sc., Agricultural Engineering,
Faculty of Agriculture, Zagazig Univ., 2011

M. Sc., Agricultural Engineering,
Faculty of Agriculture, Zagazig Univ., 2016

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ABSTRACT

Aquaponics is the combined culture of fish and plants in recirculating aquaculture systems, considered to be an innovative, eco-friendly and sustainable technology. So, the main aim of this work is to investigate to which extent the content of nutrients in water discharged from fish farms is sufficient for growing lettuce plants, in order to reduce the using of chemical fertilizers, save water, improve the plant and fish. To achieve that, two nutrients sources (effluent fish farm and stock nutrient solution), three systems of hydroponics (deep water, A shape and gutter systems) and three flow rates are 1.0, 1.5 and 2.0 L h^{-1} per plant were compared. Also, water use efficiency of lettuce plants was determined. The various water quality parameters and plant growth were studied for treatment under study. The obtained results indicated that the highest values of N, P, k, Ca and mg consumption rate were found with gutter hydroponic system and 1.5 L h^{-1} $plant^{-1}$ of flow rate for lettuce plants grown in nutrient solution. The highest value of the length of root (26.93 cm) was found with waste fish farm for deep water hydroponic system. The fresh weight of whole plant for lettuce plants grown in gutter hydroponic system was better than those grown in different culture system. The fresh and dry of shoot and root for lettuce plants grown in gutter hydroponic system was better than those grown in different culture system with 1.5 L h^{-1} $plant^{-1}$ flow rate. The water consumption and nutrient solution consumption by lettuce plants grown in A shape hydroponic system was more than those of Gutter and Deep water hydroponic systems. The highest value of the water use efficiency of lettuce plants was 46.11 kg m^{-3} was found with nutrient solution for gutter hydroponic system. The highest values of N, P, K, Ca and Mg uptake were 2.86, 0.85, 3.20, 1.90 and 0.30 %, respectively, for all treatments. The total weight gain, fish growth rate and specific growth rate were 138.9 g, 2.78 g day^{1} and 2.03 %, respectively. The total production costs of lettuce plant at the end of experimental period in stock nutrient solution and effluent fish farm were 1.60 and 1.03, 1.89 and 1.36 and 1.30 and 0.87 EGP plant^{-1} for A shape, gutter and deep water hydroponics systems, respectively. The model results were in a reasonable agreement with the experimental ones.

Keywords: Aquaponic, Aquaculture, Hydroponic, Fish, Lettuce plant, Nutrients, Water use efficiency, Root, Shoot, Weight gain, Costs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AC	The amount of chemicals.
AF	The amount of fertilizers.
AP	The chemical price.
BOD	Biological oxygen demand.
CHP	Combined heat and power.
COD	Chemical oxygen demand.
D_c	Depreciation costs.
DO	Dissolved oxygen.
DWC	Deep water culture.
E	The energy costs.
EAF	Ebb-and-flow.
EC	Electrical Conductivity.
Ec	The electrical energy consumption.
EFW	Effluent fish water.
EP	The energy price.
F&D	Food-and-drain.
Fc	Fixed costs.
Fc	Fertilizers and chemicals costs.
FCR	The feed conversion ratio
FER	The feed Efficiency ratio.

FGR	The fish growth rate.
FP	The fertilizer price.
HDF	Hybrid-denitrification filter.
HVP	Hydroponic vegetable production.
I_n	Interest costs.
IRR	Internal return rate.
L_a	Labor costs.
LAI	Leaf Area Index.
NFT	Nutrient film technique.
NPV	Net Present Value
NS	Nutrient solution.
P.B.P	Payback period.
P_m	The purchase price of the system.
PVC	Polyvinyl chloride.
RAS	Recirculating aquaculture system
RLD	Root length density.
R_m	Repair and maintenance costs.
RMSE	Root means square error.
SGR	The specific growth rate.
TAN	Total ammonia nitrogen.
Tc	Total costs.

UVI	University of the Virgin Islands.
Vc	Variable costs.
WG	The fish mass gained.
WUS	Water use efficiency.
ΔDW_{root}	The daily amount of root dry mass increment.