LABORATORY OF Phytopathology

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Biofilter in aquaponics

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INTRODUCTION

Aquaponics is a combination of aquaculture (fish farming) and hydroponics (horticulture). Compared to hydroponics or aquaculture alone, this combination has many attractive advantages like energy and water savings, decreasing of chemical inputs such as fertilizers, antibiotics and pesticides and also minimizing the release of pollutant effluent.

In this concept, the fish feces and excreted ammonia are partially transformed into soluble nutrients which then are available for plants. Basically, wastewater from aquaculture is filtrated by passing through a biofilter colonized by microorganisms and a hydroponic bed planted with vegetable or culinary herbs and return to the fish tank in a loop cycle (fig 1).

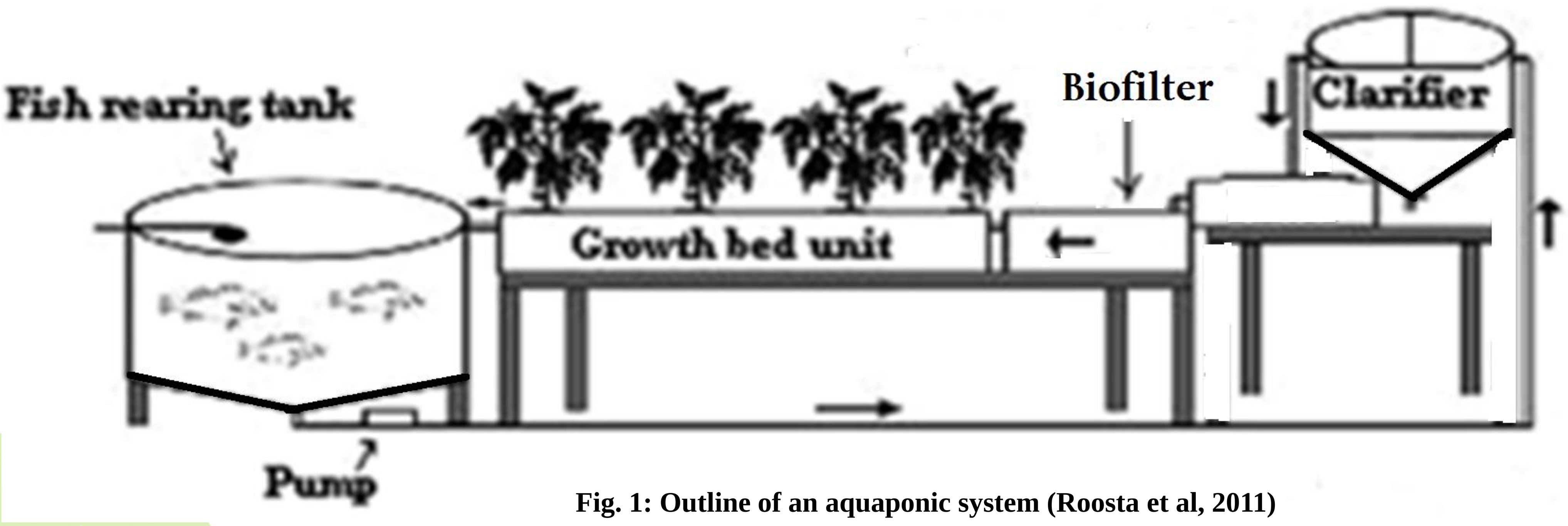

Fig. 1: Outline of an aquaponic system (Roosta et al, 2011)

CONTEXT

Good knowledge and best practices are already available for aquaculture and hydroponics separately. The combination of both in aquaponics has not been extensively studied and there is a lack of knowledge in many areas.
The role of the microbial communities is not well characterized while its role is essential by providing many functions in the aquaponics ecosystem.
Amongst these roles, the microbial communities allow the integration of aquaculture and hydroponics by processing the fish feces into soluble nutrients easily assimilated by plants, e.g. nitrifying bacteria convert free ammonia into nitrite and then nitrate absorbed by plants.
Maintaining and optimizing the effectiveness of these communities is a major concern for the development of aquaponics.
It's therefore mandatory to characterize these communities and to study their role in the solubilization of the elements needed by the plants. Our laboratory is developing and studying urban agriculture with an important focus on aquaponics by running several prototypes (fig 2 and 3).

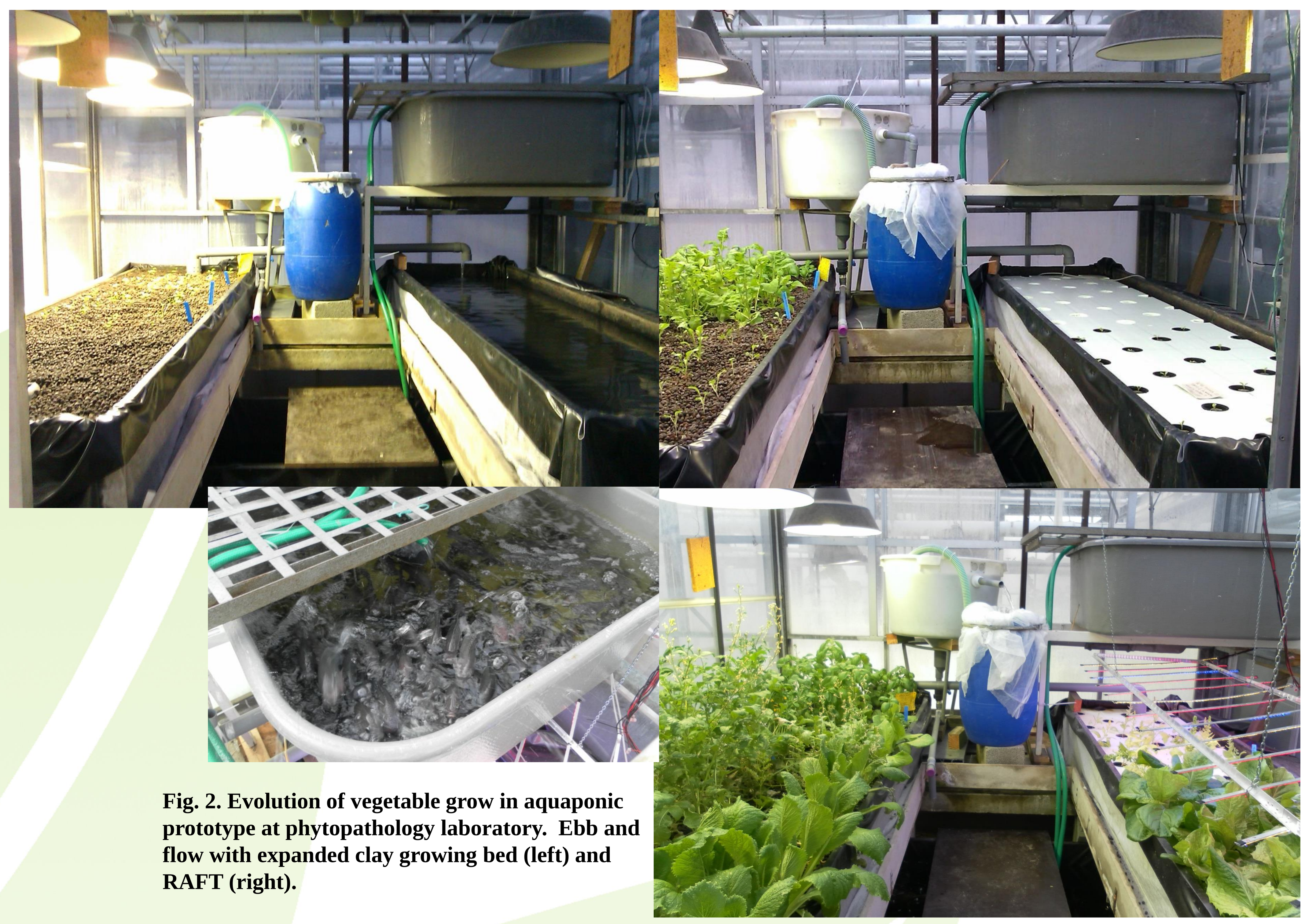

Fig. 2. Evolution of vegetable grow in aquaponic prototype at phytopathology laboratory. Ebb and flow with expanded clay growing bed (left) and RAFT (right).

Fig 3. PAFF Box, aquaponic prototype at phytopathology laboratory. NFT lighted by LED technology

OBJECTIVES

Main objective: improve the performance of aquaponic systems by optimizing the efficiency of microbial communities to solubilize nutrients for plants

1. Identify and quantify the elements necessary for plants (N, P, K, Ca,…) present in the fish waste and in which form they are available
2. Identify species and genes/pathways involved in processes to solubilize fish waste into plant nutrient
3. Use biomarkers to verify the presence or activity of these genes in biofilter indicating good operating state
4. Extensive study of best design condition to optimize solubilization rate by the microbial communities

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