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Organic Hydroponics Production**Wafaa M. Haggag^{1*} Fawzy Z.F² El Sawey S²**

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ABSTRACT

Hydroponic culture is a controlled systems use a soilless growing media, supply all of the plant's nutrition in the plant's solutions (water with dissolved fertilizers), result in higher yields of vegetables, flowers, herbs and others crops. Hydroponic systems derive in many various forms and types. Most traditional hydroponic systems are extremely specialized, controlled-environment production systems. Organic hydroponics is a system that is arranged based on organic agriculture of culture. Different approaches are used for controlling of plant pathogens such as physical, chemical, biological controls, biofertilizers, bioremediators and integrated pest management. All the required nutrients are supplied in controlled amounts, including organic crops. This article discuss the way for promoting organic hydroponics systems and to help the small-scale producer make decisions about follow this markets, production methods, and disease control.

1. Introduction

Hydroponics is basically plants that grow without traditional soil ^[1]. It is a more impact to provide increase productivity of plants. Plants do not use traditional soil - they use food and water in the soil. The function of the soil is just to supply plants with nutrients and to root plants. In the water park, provide plants with a complete nutritional formula and an inert growth medium to anchor the roots of plants so that food and water are easily accessible.

The management of organic hydroponics it needs much more attention than conventional hydroponics. Not in terms of elapsed time, but in terms of "visual attention". In fact, are organic hydroponics administered by eye the same as with pH and EC, although they are still important

references ^[1].

Hydroponic solution is developed by National Agriculture and Food Research Organization (NARO), in Japan, in 2005 ^[1]. Originally, 'organic culture' it is means nutrients that promote a healthy plants is developed by European regulation 834/2007 on organic agriculture. The National Organic Standards Board defines organic farming for an aquaculture system as "an environmental production management system that promotes and enhances biodiversity, biological cycles and soil biological activity." ^[2]. The National Organic Standards Board has made recommendations on organic hydroponics for plants and fish. In November 2017, the US is arranged a rule of organic hydroponics with label and certifies. In spite of the opposition of many organic stakeholders, some accredited certifying agents are approving hydroponic process. The

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United States is joining with 24 other countries, including England, the Netherlands, and Mexico, in prohibiting organic certification for hydroponic produce ^[2]. Organic and conventional production systems run on the same rules of supplying nutrients in solution to support growth of plants. Studies for promoting organic hydroponics have been processed for a long time. The main variation between the two systems “conventional systems supply chemical components for nutrient supply” and “organic hydroponics” is the fertilizers and pesticides that will dissolve in water in the conventional system but in other one “organic hydroponics” the use of chemical fertilizers and pesticides not allow to do that. The first feasible organic hydroponics systems that organic fertilizer and microorganisms can be added immediately during cultivation in Japan that ^[2] invented the new method to originate organic hydroponic system which consists of three handling: (1) inoculation of soil beneficial microorganisms, (2) adding of small amounts of organic fertilizer, and (3) aeration. In this system, terrestrial plant roots are not in soil but sort in air, water, or a solid medium, such as vermiculite, coconut, or perlite. The roots are periodically dipped in water or bathed in a nourishing and organic solution ^[2].

2. Beneficial Microorganisms in Hydroponic Systems

The beneficial microorganisms can be used in the hydroponic and aquaponic systems which play a major role in the system to give clear and safe production of fruits. In hydroponic systems, most of the microbial work focuses on the some special kind of bacteria ^[3]. Microorganisms can be used in an organic hydroponic system, by organic fertilizer decomposing into inorganic nutrients in aqueous solution by treatment with ammonia and nitrification ^[1,4]. Organic hydroponics systems works through a symbiotic relationship between microorganisms and plants which is necessary to provide additional microbial habitat. Microorganisms are provide a base for beneficial to reproduce and from which they can colonize plants.

3. Biofertilizers Strategies in Hydroponic

Growth promoting root bacteria (PGPR) strains and fungi have already been successfully tested in growing vegetables and fruits in aquatic systems, with positive effects on growth, yield, product quality and safety ^[3]. These differences, and especially the vital nutrient fraction, could investigate several factors and play a critical role in contributing to plant nutrition ^[5]. The different mechanisms are known by PGPRs by increasing the bioavailability

of mineral nutrients in the root zone (i.e. fixation of N₂ in the atmosphere, dissolution of P, production of iron acid for Fe³⁺ + chelation) ^[6]. Interestingly, the application of specific PGPRs, such as *B. sphaericus* UPMB10 and *A. Brasilense Sp7*, nitrogen fixation (N₂), reduced the external input of nitrogen sources into the aqueous solution used to grow banana plants without soil ^[7]. A mixture of PGPRs cultured in hydroponic systems of food crops such as wheat, potatoes, and soybeans was introduced for a complete life cycle, and the formation of these microbial communities was related to their roots, rhizomes, and endosphere. A recycled nutrient solution was described via the 16S - sequence ^[8].

There are technical difficulties, such as the management of chemicals and root by-products, which hinder the implementation of more closed aquaculture. Limited studies have been conducted on the use of materials of organic origin such as muddy manure and compost sap but cannot be replaced with a chemical solution ^[9-13]. With complementary organic matter, there is a need to analyze organic matter to avoid any damage from increased nitrogen level and the system remains dependent on the continuous input of external organic matter.

Organic hydroponics aims to create a mixed technology between the ancient known soil culture and the new concept of hydroponics to create a sustainable and environmentally sound production system ^[13]. Many researchers are trying to create a hybrid technology that can have more benefits with fewer problems compared to conventional soil and hydroponics. The goal was to make it as completely sustainable as a micro-environmental cycle. By extracting nutrients from the soil and exposing them to plant roots in liquid form, plants can absorb the minerals they need and the roots are re-secreted into the soil in a closed system, where they can interact and release excess minerals from the soil. The result will be a hydroponic system, which will be sustainable, easy to manage, cost-effective and environmentally friendly system.

Some work on organic hydroponics has already been implemented with supplementary feeding solutions but a fully sustainable system has not been introduced. Creating an organic self-sufficiency system for horticultural production not only responds to consumers' demand for these naturally managed crops, but also reduces the cost of production and simplifies the production process as preferred by the producers and can be considered a response to public sector demand in an environmentally friendly way to produce a greenhouse. Furthermore, expect a decrease in the incidence of disease in this system due to the great impact which can create a balance

between all opposing parties giving the opportunity for plant growth. It can be concluded that the organic approach can extend to the organic hydroponic system with acceptable yield and quality. Using this system especially for food crops could be more attractive due to strict legislation on chemical waste and hazards. The following elements define the benefits and potential of a sustainable organic hydroponic system; in custom biodynamic systems, plants are given a pre-defined formula, which is ideal based on past experiences. Given that environmental factors actually change in the long term and at diurnal scales, in reality, plants cannot get what they want with the required consistency. In a sustainable organic water system, the plant can interact with the medium and can influence the concentration of certain nutrients by managing both the concentration and diversity of root exudates. Therefore, plants in this system can react to environmental stimuli and stresses through active interaction with the soil component of the system. The system is much simpler in terms of preparation and management compared to the traditional water system, so the related tool and labor costs are greatly reduced.

Supporting plants with better nutritional status identified through adaptive plant physiology can add value to the product through better product quality and post-harvest performance^[13]. The use of sustainable and organic methods to produce hydroponics is a significant achievement for the protected horticulture industry. Increasing consumer demand for health products resulting from lower environmental costs in the future supports such initiatives. This system can be easily adapted with organic principles to respond to the sector's demand for greenhouse products. Creating a self-sustaining production method is the key to the great success of human survival in outer space. For example, plant production units on the Moon could be established using local ore mineral sources through this approach^[12]. As a new area of research, the appropriate type of soil, the appropriate volume required for each plant, the function of the nitrogen fixation unit and the improvement of conditions to obtain the best results are the main areas that should be investigated. In addition, the stability of the system and the mode of action induced by the plant root should be examined with soil effects and soil nutrient release in the section. The role of soil organic matter in this system and the benefits of adding an appropriate type of external organic matter could be another area of research. The emergence of organic hydroponics came in the 1990s when mineral nitrogen mineralization to nitrates became possible through various steps^[14,15], despite the emergence of some challenges such as having to use

different bioreactors for ammonia and for nitrification^[16], little success in achieving this^[17], until^[4], used microbes from various sources to mineralize organic nitrogen to nitrates in the same media, which are potentially organic hydroponics has been fully achieved. Nitrogenous bacteria are cultivable for compost mineralization in various conditions such as maintaining a pH at 7.7 - 8.4, a temperature of 35 ° C, 6.5 mg / l of dissolved oxygen, or some parameters such as temperature at 25 ° are different. The resulting nutritional solutions to crop production have already demonstrated benefits such as the effectiveness of both controlling soil and airborne diseases in vegetables such as lettuce and cucumber^[18]. This development comes as a relief for societies with less financial ability to access hydroponics through organic sources of plant nutrition requirements. This considers that the use of traditional fertilizers for agriculture is relatively expensive worldwide^[19], especially in Africa^[20].

4. Bio-Control Strategies in Hydroponic

Plant pathogens occurring in hydroponics systems are generally found in soilless systems especially of hydroponic plant culture is the continuous presence of water in the system. This environment is suitable for most types of fungi and plant pathogenic bacteria. Soil-borne fungi, such as *Fusarium spp.*, *Phytophthora spp.*, *Rhizoctonia*, *Macrophomina* (Figure 1), and *Pythium spp.* *Vorticillium* and *Didymella* are among the most problematic pathogens due to their preference for moist environment conditions that cause especially heavy losses in leafy vegetable crops^[21]. Bacteria, such as *Ralstonia*, *Xanthomonas*, *Clavibacter*, *Erwinia*, and *Pseudomonas* are also found in Hydroponics' irrigation system that cause damage to stem, leaves and / or fruit^[22]. In the hydroponic system, the control methods are still chemical fungicides that cause toxicity to fish and beneficial bacteria (such as nitrifying bacteria in the biofilter (Figure 2)). Moreover, the development of biological control agents for use in hydroponics is still in its infancy. Through the different methods used to control plant pathogens using physical, chemical and biological methods, we focus on biological controls, especially plant growth promoting root bacteria (PGPR) which are used in bio-fertilizers, biological control agents, bio-stress and biological treatments. Experiments introducing microorganisms into hydroponic systems have focused on increasing nitrification by using nitrifying or plant growth-stimulating root bacteria such as *Azospirillum brasilense* and *Bacillus spp.* To increase plant performance and productivity^[23]. In hydroponics, various anti-microorganisms are used to control plant pathogens. There is now a rapid need to introduce bio

control agents (BCA) for plant pathogens into hydroponics and reduce the use of chemical pesticides. In general, bio control agents are easier to introduce into soilless culture systems which are more accessible than soil ^[26]. Several “bio control agents” BCAAs are effective against plant pathogens (Figure 3) ^[24-26]. A number of microorganisms useful for this study, such as *Pseudomonas spp.*, *Bacillus spp.*, *Streptomyces spp.*, *Gliocladium spp.* and *Trichoderma spp.* ^[27]. Recently, hydroponic system have begun using Arbuscular mycorrhizal (AM) fungi inoculum for increasing yields and provide sustainable

growing conditions in organic production ^[28]. *Arbuscular mycorrhizal* (AM) fungi have been shown to be able of making nutrients ready to crop plants and providing best transplant achievement by offering higher root and shoot fresh weight, biomass, growth rate as well as protect plant from diseases caused by root pathogens in hydroponic production systems ^[28]. However, Growth promoting root bacteria PGPM-treated plants were shown to be the most effective and more stable over time of most research on hydroponic systems ^[8].



Figure 1. Infected vegetables grown under hydroponic system without control system in Bohera governorate (Cultivar Station of National Research Centre during 2020)



Figure 2. Vegetables grown under hydroponic system with chemical control system in Bohera governorate (Cultivar Station of National Research Centre during 2020)



Figure 3. Vegetables grown under hydroponic system with biological control system in Bohera governorate (Cultivar Station of National Research Centre during 2020)

5. Integrated Pest Management

Diseases and insect are a main challenge in hydroponic production systems ^[28]. Integrated Pest Management (IPM) play an important role in the management of these diseases and insect and organic food production pesticides ^[29]. Diseases and insect are a main challenge in hydroponic production systems. Integrated Pest Management (IPM) play an important role in the management of these diseases and insect and organic food production pesticides ^[29]. IPM include the use of integration system from cultural, physical, biological, and natural chemical to cultivate crops with low use of chemical fungicides and. Cultural Control through an

IPM program starts via prevent pathogens and insect pests from growing in the production area . Physical control methods are main to prevent pests to build it, where possible. Biological control of pathogens and pests via an IPM program include the release of natural beneficial microorganisms and natural enemies ^[29].

6. Future Perspective

The object of this review aimed to give an effective methods and future possibilities to use organic agriculture in hydroponic using beneficial microorganisms and natural products. The use of organic matters in this system is an supporting for making use of organic

fertilizers, organic plant media or organic amendments. The use of biological control means supply of beneficial microorganisms by manipulating and managing water composition i.e. C/N ratio, nutrients and gases and pH value which is importance to sustain good nitrification and keep healthy fish. In addition, biological control by releasing of beneficial microorganisms to produce safe food and environment is needed. Integrated plant pest management (IPM) is use to management the system and reduced development and spread of plant pathogens and decreases the use of chemical pesticide. In generally, plants growing in hydroponic systems are healthy with less vulnerable to pathogens and pest rapid and attacks. In hydroponic systems, most of farms use minimal chemicals pesticides and fungicides, they may even be considered organic for safe food.

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