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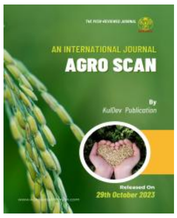

Review Article

The commonest issues and solutions regarding the hydrophonic in the greenhouse

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The development of hydroponic greenhouse systems have a number of challenges, hydroponic greenhouse farming has gained a lot of attention due to the many benefits it offers producers over traditional agricultural practices. The primary obstacles are the high initial and ongoing costs, the need for additional time and trained personnel, and the rapid transmission of diseases to plants in the circulating system. Other significant issues with this farming technique are that hydroponic greenhouse systems are susceptible to power outages, low production can arise from elemental deficiencies like oxygen, and system failure can quickly kill plants because there is no soil to act as a buffer. Furthermore, plants in hydroponic greenhouses respond rapidly to environmental changes, some of which are almost irreversible (e.g., hot weather, limited oxygenation). The issue of expensive initial outlay is mitigated by using DIY greenhouse kits, which are built from spare parts that fulfill comparable functions to those of pre-made kits. By using comparatively inexpensive alternative energy sources like wood chips and homemade solution recipes, the problem of high operating costs—which is mostly brought on by the high cost of electricity and the purchase of readily-mixed solution recipes—is reduced. The problem of requiring a great deal of dedication and managerial abilities may be somewhat reduced by automating the system and by using applications that allow sensors to transmit their readings to computers and mobile devices. This article discusses these and other issues along with the most effective ways to handle the difficulties.

Introduction

Hydroponic gardening for survival, humans need access to food, water, and a place to live. But since these components come from biotic and abiotic sources, their availability is limited, which means that maintaining biodiversity and optimizing land area is essential for human survival [1]. The demand for high-quality food species is rising dramatically due to the world's rapidly expanding population, which is expected to reach 9.5 billion people from its current 7 billion [2]. As a result, agricultural technologies like greenhouse farming and, most recently, hydroponic greenhouse farming are being adopted by humanity. This study will examine the issues that hydroponic greenhouse farming faces and provide an overview of potential fixes. The term "hydroponic" describes a farming method that uses nutrient-rich water to nurture plants rather than soil. The practice of growing plants on a growth media without soil is known as hydroponics [3].

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The most popular varieties of growth media include gravel, coconut fibers, perlite, and Rockwool. Plants absorb water via their roots much as in traditional agriculture; the main distinction is that roots grown hydroponically dangle directly in the nutrient solution, either misted by it or contained in a substrate-covered container.

Issues with Hydroponic Gardening

Expensive Initial/Startup Cost Building a hydroponic greenhouse system requires two stages: building the greenhouse and then installing the hydroponic system. Phase I was already discussed. Phase II entails the construction of a sizable, central hydroponic system that has the capacity to sustain the quantity of crops anticipated to be cultivated. A conventional hydroponic system is expected to sustain at least 44 big plants, such tomatoes, banana peppers, and belly peppers, to name a few, and at least 78 tiny plants, like spinach, lettuce, and strawberries, among many others [4]. This is according to experts. In order to do this, a large and potent hydroponic system that can sustain 104 plants in total must be installed. Purchasing such a system is costly and often beyond of reach for most average farmers. In addition to outfitting a greenhouse with a large and potent hydroponic system, it is important to install an expensive.

Arduino-based temperature control system. According to Hochmuth (2001b), the installed sensors (including light intensity, temperature, humidity, and carbon dioxide concentration) should allow the Arduino-based climate control system to monitor the interior environment [5]. An appropriate system has to be both automated and effective in regulating every variable via the management of the several equipment involved, including pumps, grow lights, louvre doors, heaters, exhaust fans, and solenoid valves, to name a few. Control systems for contemporary hydroponic greenhouses must include sensors that can transmit their data online so that any computer or smart mobile device may access the data instantly and remotely [6]. Nevertheless, purchasing such a system will cost a significant amount of money. Taig (2012) was states that the initial cost of implementing an Arduino-based temperature control system relies on many parameters, including the system's effectiveness, availability in the area, and cost of transportation, among other things [7]. However, an efficient Arduino-based temperature control system is thought to cost between $520 and $2150 for a large hydroponic greenhouse [8, 9].

Resolution -1

There are many strategies to lower a greenhouse's early beginning costs. However, it is essential to remember that regardless of the approach used, the initial cost of constructing a greenhouse must be borne. This is due to the fact that certain inputs, including the lighting devices, containers, pump, and solution, among others, need to be purchased. The most expensive component of the system is the lighting, which is also essential to its functionality [9]. The easiest way to lower the initial cost of purchasing a hydroponic greenhouse is to build the greenhouse frame out of PVC and wood rather than aluminum and steel, which will drastically lower the greenhouse's original building costs. But unlike constructions made of steel or aluminum, this one is probably not going to be as stiff and long-lasting. Glass and stiff or flexible plastic materials are two common materials used to cover greenhouses [8].

Covers whose cost fits within their budget are a good option for growers searching for methods to save costs. Instead of utilizing a glass cover, one might choose to utilize ultraviolet (UV) light-resistant polyethylene plastics, which are often fitted in two thick layers. However, producers should refrain from innovating to the point where it might endanger greenhouse output or make it more difficult to maintain the atmosphere within the building. Furthermore, it is necessary to take into account other elements including the local building rules, the structural load from the object's own weight, and external forces [10,11]. However, establishing a greenhouse is a task that not all growers are capable of doing. Before starting the procedure, those without this understanding should seek the advice of specialists or even pay them to do the task for them.

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Instead of utilizing a glass cover, one might choose to utilize ultraviolet (UV) light-resistant polyethylene plastics, which are often fitted in two thick layers. However, producers should refrain from innovating to the point where it might endanger greenhouse output or make it more difficult to maintain the atmosphere within the building. Furthermore, it is necessary to take into account other elements including the local building rules, the structural load from the object's own weight, and external forces [10,11]. However, establishing a greenhouse is a task that not all growers are capable of doing. Before starting the procedure, those without this understanding should seek the advice of specialists or even pay them to do the task for them.

The primary issue with improvising certain materials is that the resulting buildings are often not strong enough, unable to completely control the environment, and less lasting than structures manufactured of the same materials. For instance, polyethylene has a better light transmittance than glass. UV protection also lasts 4–5 years, whereas glass covering lasts more than 26 years [12]. Wells, (2014) and Tavassoli et al., (2010) state that one of the main input expenses for maintaining a hydroponic greenhouse in a narrow and precise temperature range in order to attain optimal plant growing conditions [13, 14] is maintenance and running costs. This expense is based on the price of oil or electricity, which may sometimes become quite expensive, particularly when the price of oil has increased dramatically. The additional resources needed to maintain the high concentrations of nutrients in the water to feed the plants are another significant expense that drives up the operating costs of a hydroponic greenhouse. Energy costs are also quite significant when it comes to running the fans, the sensors, and the pump that mixes the nutrients with water.

Resolution-2

Farmers have been searching for more affordable energy sources to help with the issue of the high maintenance costs associated with attempting to control the temperature range in a hydroponic greenhouse using typical fuels. There have been reports of large-scale cultivators employing wood chips or other inexpensive alternative energy sources like this in several regions of the globe, including Canada. In some regions of the planet, geothermal and natural gas energy have also been used. Geothermal energy, for instance, is thought to be a reasonably inexpensive energy source is being tested in the Netherlands, and preparations are in motion to test it in California [15]. The most popular alternative energy source for controlling temperature in hydroponic greenhouses is solar energy. The majority of growers are unable to fulfill the substantial investment requirements. This energy source's primary drawback is its unpredictability, especially in tropical regions [16].

Because their production costs are lower, producers that are located in regions with optimal temperatures and daylight hours often have an advantage in the market. Analysis of these potential remedies for the issue of excessive energy expenditures, however, indicates that the most effective way to address this problem may lie in creating more energy-efficient systems that may make use of renewable energy sources. Planting high-value crops is an additional method of controlling or offsetting the high operating costs. Specialty crops like basil, peppers (yellow and red), tomatoes, and expensive herbs often provide revenue for greenhouses [16]. It is encouraged that growers steer clear of crops with minimal market value, including grain crops, and those that can thrive in an open field. Closely spaced plantings is another tactic used by producers to increase their earnings, which would offset the expensive upkeep and running expenses [17].

Growing plants close together not only saves land since they need less area to grow, but also gives the greenhouse a more lush, oasis-like appearance, according to Steiner and Goodwin, (2011) [18]. Consequently, less land is needed to yield more product (Brown-Paul and Ross, 2014). The idea of growing plants closely in a hydroponic greenhouse combined with expensive crops might assist ease the pain of operating a greenhouse at a high cost while yet having the possibility for greater revenues [19]. Hydroponic greenhouses need a high degree of management, which often calls for managers with training and experience, particularly when a project is started for profit. High management skills are necessary for the commercial production of any crop in hydroponic greenhouses, according to Shaw et al. (2001) [20]. It is important to remember, too, that the complexity of the system has a significant impact on the management level. As an example, although commercial growers do need skilled and knowledgeable staff to regularly monitor their systems, the majority of their systems are entirely automated, requiring little administration of the hydroponic portion of the system [21].

Hydroponic greenhouses are very exacting and demanding systems that need management to have more production knowledge, technical abilities, and enough experience than any other greenhouse system, according to He and Ma (2010); Cantliffe and Vansickle (2012) [22, 23]. Growers must be dedicated to fulfilling all requests in a timely and efficient way for the production to succeed [24]. Growers are required to periodically monitor and control the greenhouse's environmental parameters if the system is not completely automated. In tropical regions with significant seasonal variations, greenhouses must have the capacity to provide enough heating in the winter and cooling or shade in the summer [25]. Since utilizing low-quality water might put crops at danger of drawing illnesses, managers should also make sure that the water is clean and uncontaminated. For instance, according to AI-Amri (2007), utilizing county water or drilling wells are the best sources of water.

AIAmri goes on to say that surface water should never be used unless it has been verified to be free of contaminants that might pose a health risk to the crops that have been planted [26]. The germination area for producing seedlings as well as cultivar and plant selection calls for more education and expertise. Certain areas of hydroponic greenhouses are designed especially for the germination of seedlings [27]. Nonetheless, the majority of growers choose having a dedicated space with regulated lighting, seats, and other amenities that is apart from the facility artificial illumination using high-pressure sodium lights or cool white fluorescents [28]. The management faces a major risk of huge losses and inconveniences if they are unable to regulate this environment, preventing the seedlings from growing in the best possible setting. Growers are also encouraged to let professionals choose their crops, particularly if they are inexperienced. Depending on the farm's location, producers should plant high-value crops and those especially designed for greenhouse cultivation, according to Alexander and Parker (2010).

Considering the high initial and ongoing costs of operating a hydroponic greenhouse, selecting the incorrect crop might lead to losses [29]. Planting high-value crops that are in demand and that are dependent on market trends might help offset the high production costs. To produce crops of the highest caliber, crop production also demands dedication and a high degree of expertise. Hydroponic greenhouse systems use a wide range of approaches, which are primarily determined by the system's configuration—closed or open, active (continuous flow) or passive (static); aggregate or liquid [30]. Growers are required to use the method that works best for them, taking into account the kind of crop as well as other elements like the system type that were previously mentioned. However, the most popular production techniques for closed systems—those that provide the recovery of excess nutrient solution after it has been used—are the floating raft technique and the nutrient film technique (NFT). Adding nutrients to the water, controlling pests, harvesting, and storing are additional labor-intensive tasks that need for specialized care. Growers may buy hydroponic greenhouse systems ready-to-mix products based on a variety of accessible recipes [31].

Alternatively, based on the kind of crop being cultivated, they may make their own customized recipe. The majority of gardeners prefer to alter their own nutrient formulations, but doing so without any margin for mistake calls for a high level of expertise. It is important to remember that since hydroponic nutrient solutions lack the soil's buffering ability, the pH of the solution is likely to fluctuate throughout production [30]. Thus, an expert must keep a constant eye on the pH as well as the temperature, oxygen levels, and soluble salts. Both harvesting and storage need a significant amount of effort, both skilled and semi-skilled. Because most of the product harvested from hydroponic greenhouse systems is very perishable and must be of the greatest quality possible for the market, the exercises also demand a sufficient level of knowledge and expertise [32]. Every kind of crop cultivated in the systems needs a different method for harvesting and storing it. For instance, while very long roots are often clipped or wrapped around the lower stem for packaging lettuces were frequently picked with the roots remaining attached. a designated area set off from the rest of the building, equipped with seats, a regulated atmosphere, and artificial illumination provided by high-pressure sodium or cool white fluorescent lights [28]. The management faces a major risk of huge losses and inconveniences if they are unable to regulate this environment, preventing the seedlings from growing in the best possible setting. Growers are also encouraged to let professionals choose their crops, particularly if they are inexperienced.

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Since all of these procedures involve a lot of effort, specialists must oversee them. The Ohio State University estimates that producing lettuce in a 3,000 square foot hydroponic greenhouse takes around 140 hours, plus an additional 1,500 hours for harvesting, packing, and marketing. According to Vollebregt and Brantford (2014) and Rathinasabapathi (2011), success in this contemporary kind of farming requires a high degree of accountability and dedication [33, 34]. Whether or if hydroponic farming is mechanized, it still needs constant, focused care. It is necessary to supervise the whole process and prevent serious issues before they arise [35]. People who initially devote a fair amount of time to learning how the system works, how to communicate with plants, and how to make the system work are often rewarded greatly, while others who refuse to make this admirable effort end up disappointed [32].

Resolution-3

There are many methods to acquire high level management abilities, which is an issue. Enrolling in a school that provides specialized instruction on hydroponic greenhouse management is the first and most important method. These days, there are a lot more institutes providing this instruction since society is continually embracing this clever technology. Individuals who are interested in obtaining training may get it from companies that provide these kits or from universities where hydroponics is taught as a distinct field of agronomy [30]. Using smartphone applications and automating the whole system is the second tactic that aids in managing the issue of hydroponic greenhouses, which calls for advanced and specialized management abilities [36]. The majority of contemporary hydroponic greenhouses are outfitted with control systems that include sensors.

These sensors may transmit their data over the internet, enabling remote and instantaneous viewing of the data from various devices, including computers and smartphones. Growers should be aware, nevertheless, that if they want to harvest high-quality food from their hydroponic greenhouse, automating and using sensors in the system cannot replace the essential managerial skills. d) Disease Spread and Pest Control Managing pests and preventing the spread of disease is another significant issue hydroponic greenhouse systems must deal with. Because other plants in the hydroponic greenhouse use the same mixed-water solution as their source of nutrients, DeKorne (2009) asserts that careful management is necessary to avoid and diagnose infections in advance [37]. Failure to do so may result in a speedy spread of the diseases to other plants. According to Puri and Caplow (2009) and Jensen (2007), maintaining a high standard of cleanliness is the only way to create a system free from illness [38, 39].When water-borne pathogens like Phytophthora and Pythium are introduced into hydroponic greenhouse systems, the majority of deadly illnesses strike. Due to their mobile spores, water molds quickly spread to every crop in the circulation system [40]. Since there is currently no approved fungicide that can manage these infections on greenhouse crops, an outbreak of the disease would inevitably result in the total loss of the sown crops.

Resolution- 4

According to Nichols and Lennard (2010), keeping a high standard of cleanliness is the best way to stop an outbreak and the transmission of infections in a hydroponic greenhouse [41]. Before planting new crops, experts also advise producers to empty all solution tanks and thoroughly clean all of the equipment with a bleach solution or any other appropriate disinfectant. The benches and germination systems need to be cleaned and cleared of any infestations in the event that an infection epidemic occurs in the germination area. It is important to remember that, while certain illnesses need the use of specialized techniques, the majority of diseases that might spread to all other crops in the circulation system can be avoided by maintaining a high standard of cleanliness [42].

Adopting the necessary precautions to keep mites and insects like aphids, whiteflies, and trips out of the greenhouse is another successful method of stopping outbreaks and the development of illnesses in hydroponic greenhouses. If sidewall ventilation is used, installing insect screening on the building's sides is one of the best methods to keep insects out of the greenhouse. Any additional point of entry should also be screened for insects [43]. Additionally, plants should be examined every day to look for indications of pests, illnesses, and mites. If there are any indications that an infestation may be occurring, act quickly and Appropriate actions need to be taken to stop it from getting out of control. One of the best ways to stop the spread of illness is to remove contaminated plants as soon as they are found [43]. Using insecticides with greenhouse labels is one of the additional precautions.

There aren't many insecticides that are approved for use in greenhouse agriculture, especially for some crops like lettuce, according to Takashima (2007) [44]. To quickly address the issue, this necessitates the use of preventive management strategies in addition to early illness detection techniques. The nutrient solutions that are used to feed the plants provide the perfect environment for algal development. However, as algae prefer moist, well-lit environments, darkening solution tanks might stop their development [45]. Water-borne pathogens and water molds like Phytophthora and Pythium are the main causes of the severe illnesses that affect hydroponic greenhouse systems. Due to their mobile spores, water molds quickly spread to every crop in the circulation system [40]. Regretfully, no approved fungicide is available to control these infections on greenhouse crops, which implies that a disease breakout will always result in the total loss of the sown crops.

Resolution- 5

Other issues with hydroponic greenhouses include their susceptibility to power outages, the possibility of low production due to elemental deficiencies like oxygen, and the possibility of rapid plant death in the event of a system failure because there is no soil to act as a buffer. Furthermore, plants in hydroponic greenhouses respond rapidly to environmental changes, some of which are almost irreversible, such heat waves or restricted oxygenation [23]. However, they are manageable and predictable difficulties that may be avoided if appropriate preparations are made beforehand. For instance, making sure there is a power backup or an alternate energy source available at all times may help avoid the issue of power outages [46].

Making sure that the system is regularly checked and maintained will help to prevent the issue of system failure. Weiner (2009) states that the hydroponic greenhouse should ideally be inspected every day to make sure everything is functioning as intended [47]. Any issue that is discovered has to be fixed right away. Furthermore, since automating the system causes changes in the greenhouse's environment that sensors can detect, it plays a key role in identifying any malfunctions. However, farmers shouldn't only depend on the sensors, according to Nicholls (2013) and Brown-Paul (2013), since they sometimes miss changes. Rather, they need to be examining the system. as much as feasible by hand [48,49].

Hydroponic greenhouse farming is one of the most innovative and sophisticated farming practices available, although it still faces many difficulties in producing crops. Higher productivity is the outcome; plants may be cultivated year-round and anyplace; the system conserves water by over 90%; it guards against soil-borne illnesses; and plants develop twice as quickly as they would in an open field [50]. Additional benefits include the fact that hydroponic greenhouse farming requires less area than traditional farming and that the product collected there has been shown to have greater nutritional content than that of open-field farming [51]. Generally speaking, the advantages of using this strategy much exceed the drawbacks [52]. However, further study is required to provide long-lasting and cost-effective answers to the issues raised in this work.

Summary

Hydroponic greenhouse systems have many major drawbacks, including as expensive initial and ongoing costs, labor-intensive setup and maintenance that requires more time and expertise, and the rapid spread of illnesses to all plants in the circulation system. Other difficulties with this farming technique are that hydroponic greenhouse systems are susceptible to power outages; lack of certain elements, like oxygen, can cause low production and consequent losses; and the fact that a system failure can cause a plant to die quickly because there isn't any soil to act as a buffer. Furthermore, plants in hydroponic greenhouses respond rapidly to environmental changes, some of which are almost irreversible, such heat waves or restricted oxygenation. By building handmade greenhouse kits out of improvised materials that have comparable functions to those of ready-made kits, the issue of costly initial capital may be mitigated. By using comparatively inexpensive alternative energy sources like wood chips and homemade solution recipes, the problem of high operating costs—which is mostly brought on by the high cost of electricity and the purchase of readily-mixed solution recipes—can be reduced. By employing applications that allow sensors to relay readings to devices like computers and phones, as well as automating the system, the problem of requiring a great deal of dedication and managerial abilities may be somewhat reduced. Growers should be aware, nevertheless, that using sensors and automating processes will not be able to replace the managerial abilities required to run a hydroponic greenhouse efficiently.

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