Basics of No Soil Farming - Hydroponic Preparation: Dr Shaheer Abdullateef

Introduction to protected agriculture:
Host: Protected agriculture is one of the most important ways to increase food production in the unit area and enhance food security. It is known as growing in private facilities, called protected houses/glass/plastic houses/tunnels. What is protected agriculture, and what is its importance to agricultural production?

Guest: Farming in protected agriculture occurs under controlled climatic conditions, often earlier or after open field farming times. Time is an indefinite factor here, and production is possible year-round. Within these houses, plants have the same environmental conditions as their vegetable and fruit growth in terms of temperature, intensity of lighting, and humidity to achieve the greatest possible production per square meter.
Protected agriculture is essential to:

- Off-season production - a necessity, especially for vegetable production, planting and seedlings
- Special-purpose production - controlling the production conditions for the purpose of agriculture (paper/fruit/syphilis/root, early/late) year-round.
- Overcoming unfavourable conditions for agriculture (climate, soil, water, etc.)
- Protection / Minimizing Pest Damage - Regulating the Use of Pesticides
- Vertical expansion of unit area production
- A greater economic return - production of fruits and vegetables not from local area

Introduction to Soilless Agriculture:
Host: Agriculture without soil or hydroponics is one of the most important modern production methods, particularly in protected agriculture. Rationalisation of water consumption in agriculture is an important vital issue that increases production while reducing water consumption. What is soil-free farming, and why has it become so popular?

Guest: Over 60% of water resources are used in agriculture, and hydroponics is an effective technology to rationalise water use in agriculture. It can be applied at the house, farm or commercial level. Its a combination of methods in which crops are grown and produced using nutrient solutions alone rather than soil. Its advantages include:

- The ability to control optimal growth conditions of a plant, especially better control of nutrients and water
- Farming anywhere, regardless of the soil quality
- Economising water and fertilisers because there is no loss in soil
- Automatic control, reduced labour costs
- Efficient use of water (75% in tomatoes for the same production), where there is no loss due to leaching or evaporation (in the case of good management, loss in water is equal to transpiration only)
- Reduction of the use of pesticides, especially to control pests that inhabit the soil (insects, fungi, nematode and grass)
- Optimise plant yields and quality. For example, fruit is solid and more storable, and the quality of the fruit can be controlled by nutrient solution composition (e.g., increased acidity in tomato fruit)
- An environmentally friendly method, with the potential to be applied to the scale of home farming, as I mentioned
- Hydroponic products are becoming more desirable in many countries as clean and healthy products.

Host: Before moving on to the benefits of hydroponics, what are its challenges?
Guest:

- Need expert labour
- You need to use special equipment such as a nutrient acid measuring and concentration device.
- Energy source, establishment costs are relatively high (on a commercial scale)
- Requires ongoing monitoring
- Sensitivity of a solution that is feeding changes in its components, EC, PH

Traditional soil agriculture provides a nutrient supply to plants, but hydroponics, being unsown, means that we have to feed the plants according to their needs. This is a feature and, at the same time, a challenge, as it requires close attention. In subsoil agriculture, plants absorb nutrients from a nutrient solution, so the concentration of nutrients decreases over time. We must make up for that by adding new ingredients into a concentrated solution, as we shall soon see. So this can be likened to serving a meal to a plant once or twice a day.

Host: Where can farming be done without soil?

Guest:

- Protected homes: especially for the production of vegetables, seedlings, plantations, ornamental plants, and fodder, such as barley
- Exposed places: particularly vegetables (for example, roofing) and ornamental plants in nurseries

Host: Does no soil mean no soil? Are there any types that use some soil or other materials?

Guest: Yes, there are methods of hydroponics that use soil. These are divided into two categories according to the type
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- Organic materials: These are used with an open system and include materials such as compost, sawdust, bitmos etc
- Inorganic media: These are used in hydroponics in a closed system, such as rock wool, incense, coconut fibres (organic but not easily decomposed during cultivation), perlite and others.

Host: You mentioned an open system and a closed system. What are these systems?

Guest: The difference is simply due to the irrigation method or how the nutrient solution is pumped to plants.

- Open system: The plant-based solution is pumped in, and the excess is not returned to the solution's nutrient tank. For example, plants are grown in lines, and the nutrient solution is prepared in a tank. The nutrient solution is pumped to the plants by drip irrigation. Here plants are grown in an organic medium, as we mentioned, so this method is similar to farming in soil. The difference here is the organic material is not typically soil, and the plants are being irrigated with a nutrient solution rather than water. This method is widely used to produce seedlings and ornamental plants in nurseries and to grow strawberries and leafy plants. This method is affordable and straightforward. It is a halfway method between growing in both soil and water. I wanted to point it out so that it would be clear that this is not exactly hydroponics.

- Closed system: It is a system employed in hydroponics, in which the nutrient solution is prepared in a reservoir and is pumped into a closed circuit, in which the excess returns to the reservoir. So here, the nutrient solution is only lost to the plant or evaporation. Several models for this method exist. They vary in how they grow plants and how they pump the nutrient solution to the crops.

Host: There seems to be more than one method or model for hydroponics. What are these methods?

Guest:

- Farming in stories, packaging or bags: They use a drip irrigation system. This method depends on the delivery of a nutrient solution to plants by drip irrigation pipes. Seedlings are planted in a 2% mile basin or basin. Any unused nutrient solution collects in a basin and is reused after the acidity and nutrient levels have been adjusted. As I mentioned here, we use an inorganic medium such as a barlet or a mixture of perlite with coconut fibres or rock wool (the same wool used in ovens to isolate heat but manufactured for agriculture). This method is suitable for growing fruit, vegetables or plants that need a vertical area for growth, such as tomatoes, cucumbers, aubergines, etc.

- Method of cultivation in pipes or channels: It uses a nutrient tape irrigation system (NFT). This method involves pumping a small amount of nutrient solution continuously in a thin flow (a nutrient slice technique). It is designed by plant and by production route (horizontal-vertical) at a suitable slope of 2% to allow the flow of a nutrient solution from one end to the other. The nutrient solution gathers in a small pool at the end so it can be pumped back into the system. This method is suitable for plants that do not grow very vertically (short plants), like leafy vegetables of all kinds and strawberries, onions, garlic and others. It is a good idea to plant tiers to exploit the available space. In this way, we do not need an agricultural medium. The plants are planted in small cups, which are punctured to allow room for the roots.
- Water culture method: Water culture agriculture. A nutrient solution is an agricultural medium (plant root mean), where basins are filled with nutrient solution and plants are loaded onto perforated cork plates (polystyrene plates). A pump is installed to move the nutrient solution and mix it with air to avoid the water becoming stagnant. This method is suitable for leafy vegetables, especially lettuce, for example.
- The method of immersion and discharge in the agricultural basin: Farmed here in containers under cultivation or directly in the basin, the nutrient solution is pumped into the basin regularly. The nutrient solution rises in height and is discharged from an opening in the basin to the nutrient solution assembly tank. The process is repeated every time from a quarter to an hour, depending on the plant. This method is well suited for producing leafy vegetables and ornamental plants.
- Aerobic cultivation method. A basin is prepared in which a mist of nutrient solution is continuously sprayed on the plant roots. The basin is covered with slices of cork, where plants are grown. The green part stays on top of the cork while the roots grow inside the basin. Here the roots grow in the middle of an antenna saturated with moisture. This method is considered one of the most high-tech forms of cultivation without soil. You need systems to control the pumping of the nutrient solution. One of its advantages is that roots grow in an ideal medium, so they fit most plants.

Host: It seems that agriculture without soil or hydroponics, in general, depends mainly on the nutrient solution. How is the nutrient prepared, and what are the appropriate concentrations of the nutrient elements in it?

Guest: Well, a nutrient solution is what sets agriculture apart and is key to its success. In soil agriculture, plants take their nutrient needs from the soil or fertiliser that the farmer has added. Thus, when there's no soil, there's no nutrient source. All the plant's nutrients come from the solution. So the nutrient solution is fundamental. However, it's easy to prepare, and its components are available. It just needs to be precise. First, we need to distinguish two types of solutions:

- Concentrated solution: It is the primary solution with a high nutrient concentration, for example, 10 or 100 times, compared with the nutrient solution. This solution is prepared as needed, stored, prepared and concentrated. This solution is prepared in two boxes: A-centered solution, B-centered solution. There are many combinations and concentrations which vary according to the plant, type of manure and soluble available on the market. In general, I'll give the nutrient concentrations to most plants: nitrogen 200 with/l, phosphorus 60 with/l, potassium 300 with/l, calcium 170 with/l, magnesium 50 with/l, iron 6 with/l, manganese 2 with/l. In addition to a mixture of small elements, an additional 100 millilitres per 100 litres of nutrient solution is added. In practical terms, as I mentioned, we have Solution A, Solution B. Previously, these solutions were created from the physical compounds themselves, but you cannot buy these compounds on the market. Instead, they are available to us in the form of soluble compost, so I will mention the structure based on the availability of these fertilisers in the market to prepare 10 litres of concentrated solution 100 times.

Solution A: calcium nitrate 1000 g, potassium nitrate 350 g, iron chiles 30 g, nitric acid 50 ml
Solution B: magnesium sulfate (English salt) 400 g, potassium nitrate 350 g, synthetic fertiliser (NPK) 12:12:36, nitric acid 50 ml
nutrient solution: It's a solution that will be pumped into a plant and prepared from a concentrated solution by adding equal quantities of a solution and a solution, for example, to prepare 100 litres of a nutrient solution, add 1 litre of Solution A, and 1 litre of a Solution B, and then adjust the focus to be EC=2.2 and PH=6.5
Check the pH level of the water first, and if necessary, adjust the pH level of the water to 6.0. Then, add a calcium nitrate solution and slowly stir the water until the solution is thoroughly combined with the water. Then, add the standard solution and stir again for a short time.

Host: With this information, preparing a solution seems easy. Are there matters to consider when preparing a nutritious solution?

Guest: Of course, as I mentioned, preparing a nutritious solution is easy but at the same time accurate. Some things must be taken into consideration to prepare a nutritious, healthy and helpful solution for plants, including:

- High-quality, reliable soluble fertiliser
- Fill the solution tank with water to 90% of its final size, and add the concentrated solution.
- The quantities stated shall be added successively in the preparation of the concentrated solution with continuous movement.
- The smaller elements are added first and then the larger ones.
- Switch nutrient solution every two weeks.
- Water lost by transpiration must be compensated daily so that the volume of the nutrient solution remains as stable as possible.
- The PH must be monitored. Maintain a pH between 5.6 and 6.5, and modify when necessary by adding potassium hydroxide when it is below 5.6 or phosphoric acid when it is above 6.5
- The nutrient's concentration should be monitored twice a day at least to maintain the appropriate range of 2 -3 millimetres. You can increase it by adding equal quantities of the concentrated solution A and B and reduce it by adding water.

Host: You mentioned monitoring the concentration of a nutrient solution. How do you check the concentration?
Guest: You can check the concentration in the middle of agriculture, in the nutrient solution channel or the assembly basin, depending on the method.

Host: Each cultivation method has its own set of conditions for success. What are the conditions for the success of a hydroponic farm?

Guest:

- Provide nutrients at the correct concentrations for the plants
- Provide oxygen sufficient for root (plant) growth
- Block the light from the roots
- Daily tuning of nutrient concentration
- Daily tuning of PH levels

Host: What advice do you give to those who want to try hydroponics?

- Growth conditions such as heat and light do not change with either protected or hydroponics.

- Four main factors usually determine a crop's success: nutrition, light, water and vegetation growth volume. In hydroponics, we provide plants with the water and nutrients they need, so these two factors cannot determine the success here. But light and the volume of plant growth remain. They still need to be accounted for. You cannot plant your crop so close together that access to the plant is limited. Also, bear in mind that the size and nature of the plant growth do not change in hydroponics. On the contrary, they are at their best in hydroponics. Therefore, it is not advised to reduce the distances between plants from the distances recognised in protected agriculture in general.
- Best agriculture method: These are determined by how the plant grows. For example, leafy vegetables suit being planted in basins or canals and castes. In contrast, fruit vegetables such as tomatoes and peppers are not suitable for growing in tiers but must be in lines (channels) on the ground.
- Cultivated species: We can plant any plant in hydroponics, but we suggest carefully planning what you grow to maximise profit. For example, lettuce is available in winter at a low price. So I don't plant it. I plant tomatoes or other things in winter, but in summer, on the contrary, I grow lettuce, and I don't plant tomatoes.

He concluded by saying that agriculture is developing day by day and has become largely dependent on technology. Therefore, we must all keep pace with this development in agriculture methods, including agriculture without soil. Everyone, the farmer, the engineer and even I, should learn all that is new, to try new ways and new plants. Hydroponics is a technology-based approach, but we can also accomplish it in simple, accessible ways. At first glance, it may seem difficult, but in fact, it is simple, easy, and just requires precision and mastery.