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>>Did you know that you can grow vegetables without soil? It's called hydroponics, and it's becoming more and more popular. And it's making it possible for homeowners who don't have a garden—or even any soil at all—to grow almost any vegetable right at home well on today's show we'll learn how to set up our very own hydroponic system, and learn how to grow everything from lettuce to strawberries. Hi, I'm Rebecca Cressman, and you're watching HomeGrown!

>>Welcome to HomeGrown, the show that brings you all the dirt on vegetable gardening. Today we're talking about how to do hydroponics—or how to grow plants in nothing but a liquid solution. Some critics say that hydroponics is too expensive or too complicated. But Professor Alfredo Rodriguez Delfin, at the University of Agraria de la Molina in Lima, Peru, has developed an easy and affordable way to set up your own hydroponic system at home. Our very own Miriam Casos traveled to Lima to learn just exactly how Hydroponics works and to see how a very determined group of women have been able to set up their own hydroponic system with great success. Let's take a look!

>>I'd like to know...what is hydroponics, and what do you mean by hydroponic system?

>>The word "hydroponics" has Greek roots. Hydro = water, and ponos = work. A quick and simple translation would be "work on water," or "growing on water." And it's a technique that allows you to cultivate plants without using soil. So a hydroponic system would be a combination of methods that we use to grow plants without soil.

>>What type of plants can I grow through the hydroponic method?

>>In principle, all kinds of plants. Plants that produce fruits such as tomato, melon, strawberries, it could be peppers, cucumbers, etc. The plants that produce leaves, such as lettuce, basil, cilantro, parsley, etc. Root vegetables, such as the potato, bulbs such as onion and garlic, it could be aromatic plants such as mint.

>>All kinds of plants, then?

>>All kinds of plants.

>>How many hydroponic systems are there? Could you give me a summary as to what my options are?

>>Well we could classify them in two big groups. One system in water, which we use to grow leafy greens. The water culture system, or NFT system. And another group is an aggregate system, where we use growing media in containers. Growing media in columns, or in a drip system.

>>Where in the house can you do hydroponics?

>>Well, you can take advantage of any part that receives natural sunlight. For instance, a rooftop or a terrace, it can be a patio; it can be a hall inside the house.

>>A hall? Can it be a balcony?

>>As long as there is enough light. One of the greatest advantages of hydroponics is that we can grow where it would not be possible to do so with traditional agriculture.

>>Okay.

>>For instance, it's difficult to grow plants in sandy soil. Or in soil with bad drainage or salty soils.

>>Which is the case for many people; they don't have good soil to grow.

>>Right.

>>Or they don't have the space.

>>They don't have the soil to cultivate. So like I said before, on the rooftops, on their patios with the hydroponics system, they could grow plants in their homes.

>>Sure.

>>Well, among other advantages we could mention are: we can produce more plants per square meter.

>>Oh.

>>For instance, if I get eight lettuces per square meter of soil, with the hydroponic system I can get 25 plants.

>>Oh wow.

>>And the time of harvest is much faster too. Due to the efficiency of nutrition in a hydroponic system.

>>Great, I would like to see it! Could you show me how it's done?

>>Sure.

>>Okay, so how do we get started?

>>We have to start by preparing the nutrient solution. And in order to do so, we need to prepare two concentrated solutions. One concentrated solution "A," and another concentrated solution "B."

>>What ingredients do I need for each solution?

>>For concentrated solution "A," we need three fertilizers.

>>Three fertilizer, okay.

>>Potassium nitrate, 550 grams. ammonium nitrate, 350 grams, and triple super phosphate, 180 grams.

>>okay. And for solution "B?"

>>For solution B, we also need three fertilizers.

>>Okay.

>>Magnesium sulfate, 220 grams. One ciliated iron, 17 grams. And then we need a mixture of micro-nutrient, which are magnesium-sulfate, boric acid, zinc sulfate, copper-sulfate, and ammonium molybdate.

The first thing we need to do is add three liters of water to a container.

>>Okay.

>>Here we have, for instance, a bucket, and the first fertilizer we add is the potassium nitrate.

>>And where can I get all these materials?

>>In agricultural stores.

>>Okay.

>>In the U.S., there are several hydroponic stores in different states. You can also get them there. Or you can buy the concentrated solutions. Since it's a soluble fertilizer, it will dissolve. Once we've added the potassium nitrate, we now add the ammonium nitrate. I cut the bag. And finally, we add the triple-super phosphate.

>>And do we have to add it in that particular order, or can we add them in a different order?

>>Yes, because the first two I added are soluble.

>>Okay.

>>So you can see clearly that it dissolves. But this one, in particular, changes the color of the solution.

>>Oh, so that one always goes last.

>>Yes, it always goes last.

>>And the water is at room temperature?

>>Yes, pottable water, or tap water.

>>Pottable water.

>>Uh-huh.

>>And I imagine it also depends on where you live, for instance if the water in your area is not good?

>>It could be well water or rain water as well. Now, if we look here for example...we are close to 4 liters, so we have to add water up until it reaches 5 liters, which is up to here. The final volume should be 5 liters of concentrated solution A. (7:54)

>>5 liters.

>>All the ingredients we have added are to prepare 5 liters.

>>To prepare 5 liters and for how much is that good for?

>>For 1,000 liters of nutrient solution, or 1,000 liters of water...

>>Ok.

>>Now we can prepare solution B.

>>Yes.

>>Then...

>>...And this takes less water as I can see.

>>Yes, because we are going to prepare 2 liters of solution B.

>>2 liters only...

>>And why that proportion? Because for each liter of water, we have to add 5 milliliters of solution A and 2 milliliters of solution B.

>>Ok.

>>You always need less.

>>So always less solution B.

>>That's right.

>>Ok.

>>So the first thing I'm going to do is add 220 grams of Magnesium sulfate to 1 liter of water.

>>Tell me, it has to be exact quantities.

>>Yes, because if we add more the plants can suffer toxicity, it can burn their leaves... And if we give less, the plants leaves will turn yellow and won't develop well.

>>Oh, all right.

>>Now, for the micronutrients, I have to use boiled water.

>>Boiled water? ...OK.

>>Yes, so here I have boiled water...

>>How much?

>>It can be 200 milliliters or 300.

>>Ok.  
>>There are many formulas, and they all fulfill the objective of feeding the plant, so we couldn't say that there is an ideal formula for all plants.  
>>Oh, I see.  
>>What's important is to use a formula that you could find in the area where you live.  
>>Sure, and in some situations, it would be better to buy it, it would be more practical to buy it.  
>>Yes, if I'm going to grow something small, for instance a 1 square meter or 2 square meter container... it's better to purchase the nutrient solution than preparing it.  
>>Sure, of course.  
>>Everything is dissolved.  
>>Yes.  
>>And now we finally add it... to prepare solution B.  
>>Perfect.  
>>And then we add the chelated iron.  
>>It goes at the end.  
>>Yes, because of the color that we will see.  
>>So chelated iron...  
>>Yes chelated iron...this gives the solution a red color.  
>>Oh! Wow.  
>>Chelated Iron provides iron to the plants and iron is a basic element for the plants because it allows them to form chlorophyll.  
>>Yes.  
>>Which is important in photosynthesis.  
>>Right.  
>>So, this is a faster way to prepare the solution than solution A. So we have to prepare 2 liters.  
>>Yes.  
>>So we'll add some water. That's why it's good to use a measuring cup.  
>>Sure.  
>>So that we can get the right amount. So, there they are, the 2 liters... So, I have 2 liters of solution B, and 5 liters of solution A.  
>>So in order to prepare 1 liter of nutrient solution, we need 1 liter of water.  
>>One liter of water...ok.  
>>Here I have a measuring cup...we are going to prepare 1 liter of nutrient solution. So, we add water...And, in order to prepare 1 liter of nutrient solution, I grab a syringe and we need 5 milliliters of solution A, I grab a syringe. 5 milliliters... We rinse...with water...for B. We take 2 milliliters of B. And I have my solution!  
>>That's it?  
>>And with this I proceed to water the plants.  
>>Now we are ready to set up a hydroponics system.  
>>That's right.  
>>Well, here we have the materials we need. I see here that you have a wood box.  
>>Yes, it's a wood box that we can use to make containers.  
>>Ok.

>>What we do is, for instance; is to cut this box and we have a small container such as this one.

>>Ok.

>>A container which is 8 centimeters high which we then have to wrap with thick, black plastic.

>>Ok.

>>Right?

>>Black plastic.

>>And after wrapping it we have a container such as this one here already water proofed

>>Water proofed, this is so that you can place the growing medium.

>>The growing medium, which can be pomez stone, quarry sand, rice shells, quartz, etc, etc.

>>You can select from a variety of growing medium, and you can mix them as well...

>>Yes, we can mix them. What's important is to use a growing medium available in your area.

>>Sure.

>>Something you can get easily...

>>Something local, sounds good... So once we have the growing medium here in the container, what's next?

>>Well, the growing medium should have been previously washed. We place it in the container and we proceed to plant.

>>We are going to plant radishes. For this, the spacing should be every 10 cm.

>>Ok.

>>We use a ruler and each 10 cms we make a shallow hole... and also on this side. Okay? And with that...

>>Sure.

>>With that line of reference I finish up right...

>>Aha!

>>And what do I do? I place 2 seeds...

>>Why 2 seeds?

>>Because one may not sprout. So if one doesn't sprout we won't have a plant in that hole. So, we place 2 seeds, or it could be one if it's a good quality seed and sprouts well...

>>Sure.

>>Then we only use one seed.

>>Tell me, all these materials that we are using right now I can also get through the internet?

>>That's right in the internet or in agricultural stores or hydroponic stores.

>>Sure.

>>Then, we proceed to cover the seeds.

>>Perfect.

>>It can be with the ruler. Or we can do it by hand, no problem.

>>Ok.

>>And once we have covered the seeds, we humidify the growing medium.

>>Ok.

>>We can use a mister bottle, or any container used for watering only.

>>Any container?  
>>Yes, the only thing we are going to add is water.  
>>Sure.  
>>Once the growing medium is moist enough, we should follow this procedure everyday until the seeds sprout.  
>>Ok... So, it's with water. You don't add the nutrient solution?  
>>No, because the source of nutrients will be the seed itself. So, once the seeds sprout we'll see the small leaves.  
>>The small leaves...What size do they have to be?  
>>They are very small.  
>>Very small.  
>>Perhaps 3 or 4 days later they sprout. And it is then when we have to apply the nutrients.  
>>Ok, after 3 to 4 days.  
>>That's right, the nutrient solution that we have prepared a moment ago...  
>>Yes.  
>>We water the growing medium with that solution.  
>>And we can put it in that...in that...  
>>Yes, in that mister bottle.  
>>In a mister bottle.  
>>Or it can be a watering can.  
>>A watering can, ok perfect.  
>>So, as the days go by the little plants are going to grow because we are feeding it nutrients.  
>>How many days, approximately?  
>>Practically from the time they sprout until the harvest they are growing. For instance, these are plants that are 2 weeks old and this other ones are 20 days.  
>>And is this another type of growing medium? This is...  
>>This is quarry sand.  
>>Ah! Quarry sand ok.  
>>Here we see the radish plants that are growing.  
>>Yes, and these are even older.  
>>That's right.  
>>How old are these?  
>>These ones are 20 days.  
>>20 days, ok... Very good! Now, with this type of system I can grow all types of vegetables.  
>>All kinds of vegetables...  
>>Ok, but I see here that you grow lettuce in a different type of system. What is the name of that system?  
>>Well, there is a water culture system or NFT.  
>>Ok...NFT.  
>>We can grow lettuce here... I could have 5 plants in this container.  
>>Ok.  
>>But the problem is that in a growing medium, lettuce takes longer to grow.  
>>So, it is more convenient to transfer it to a water culture system.

>>Yes, water culture.  
>>Oh, ok. Great.  
>>For a water culture system we start out in a container which we already explained.  
>>Right.  
>>Which has to be covered and waterproofed, because here instead of a growing medium we will add water.  
>>Water.  
>>And we are going to prepare nutrient solution for this container.  
>>And how much solution should I add?  
>>For instance, for this type of container 40x40 8 liters.  
>>8 liters.  
>>Or I can have a bigger one; I can have 10, 50 liters depending on the size of the container.  
>>Right.  
>>So for this container, we have prepared this board of styrofoam, which is one inch thick.  
>>Ok.  
>>And of a 20 density or it could be 18 since the board is hard, and this board is going to float on top of the solution.  
>>Is that so the plant has no contact?  
>>No, well it's going to have contact because this board is going to float  
>>Ok.  
>>And it's going to hold the plants.  
>>Yes.  
>>But we need to make holes in this board  
>>All right.  
>>And in order to do that we use a piece of hole puncher with a diameter such as this, which is 1.5 cms. And we heat up this hole puncher in a stove, and with the hole puncher we are going to make small holes such as these.  
>>Ok.  
>>So in these holes we are going to place the plants of lettuce for example, or basil plants  
>>Only leafy greens.  
>>Yes, only leafy greens. And the small plants will be held by a piece of sponge.  
>>Right.  
>>We cut a strip of this size, which we will show when we transplant, and the plant will be placed here, held by this board.  
>>Perfect! And is this the first stage of this process?  
>>No, the first stage would be the seedlings.  
>>The seedlings, ok...  
>>The seedlings, right? When the lettuce plants have 15 days in this stage...  
>>In the growing medium.  
>>We are going to transfer to this second stage.  
>>That's when you transfer it...ok  
>>Where they will be for another 15 days.  
>>Ok.  
>>But then the plant needs to develop.

>>Right.  
>>So we need a styrofoam board but...  
>>With bigger holes.  
>>With bigger holes.  
>>Ok.  
>>In order to make the holes, again need to use a hole puncher but with a bigger diameter. This diameter is just right to hold a little cup that would support to the plant, okay? So, in each cup I will place a plant. And why? Because in this cup as you can see, there is a hole.  
>>Oh yeah...  
>>Enough to let the roots pass.  
>>So this is the final transplant, it's the last stage of this...  
>>That's right; it's the last stage where the plants will remain for one month.  
>>One month, ok.  
>>What we do in this cups is for instance to place one plant with its root, which fits perfectly and passes through the cup.  
>>Right...  
>>We hold the plant and the cup fits.  
>>Perfect!  
>>And below is the nutrient solution.  
>>Right  
>>One thing we have to do every day is to aerate the nutrient solution.  
>>Aerate? So you don't have to change the solution?  
>>No, we lift up the Styrofoam board which has all these plants and with an egg-beater that we have at home but clean, we beat it.  
>>Oh! Twice a day?  
>>In the morning and afternoon.  
>>Ok.  
>>We can count 5, 10 and that's enough.  
>>Great!  
>>Through this action, what are we doing? Incorporating oxygen into the water and that dissolved oxygen is important for the roots to breathe.  
>>Right.  
>>That's why the roots grow well in a hydroponics system because we are aerating.  
>>Oxygen is important then so we should do this.  
>>If we don't aerate, the plant won't develop well because the lack of oxygen will affect the roots.  
>>Right.  
>>So we have the first stage, the seedlings stage.  
>>The seedlings stage.  
>>Second stage which is...  
>>Post-seedling or first transplant.  
>>First transplant, and we have...  
>>The final stage.  
>>The final.  
>>Which is the final transplant.

>>The final transplant.

>>Ok.

>>So and after seeing all of this. How did you become interested in Hydroponics?

>>It was just a coincidence because when I did my thesis on Biology...

>>Uh-huh?

>>I used hydroponics as a tool to study the toxicity of magnanimous in potato plants.

>>Ok.

>>And then when I started in the university as a professor, I used it as a tool to teach my students about mineral nutrition.

>>Mineral nutrition.

>>In a course of vegetable physiology...and since then the formula for the nutrient solution got started, and further developed it through small workshops.

>>Right.

>>And because people would visit us constantly and they could see that we produced plants without soil, they became interested and from that point on, we started working on social projects.

>>And what kinds of social projects?

>>Among them for instance, in the schools the hydroponic gardens,

>>Oh really?

>>Yes, and in some marginalized communities in Lima for instance, there have been projects to create a micro-business in the community, or family owned business with the goal to earn extra money for the family, or to improve the diet of the families because generally, the poor citizen doesn't consume vegetables in his/her diet.

>>Right, that's true.

>>And vegetables are rich in minerals and vitamins.

>>They are important for nutrition.

>>So, this can be an advantage to children especially, uh...to pregnant mothers uh...since it provides them with good nutrition.

>>Yes, that's true. Is there another project that you've done recently?

>>Well, there's a very interesting project which is very successful in this country done by a group of ladies who are in a area called Villa el Salvador. They produce at a commercial level and with the money they earn they practically pay their own salaries.

>>And what do they grow? What type of vegetables?

>>They grow lettuce. They produce approximately 30,000 plants of lettuce a month

>>Incredible! Through the water culture system?

>>Through the water culture system.

>>Sounds very interesting I would like to meet them.

>>Yeah, let's go...

>>What we've done is first of all um...to take a little bit from the technique, the technique which is within our reach, taught to us by the professor, and have applied it to our situation, in this place we live in, which is a small space.

>>Right.

>>And have made it affordable for us, so that we can financially support our families.

For me, it's been a very good experience because I've seen many women like me

um...feel productive, successful, and to see with great joy how we produce something, which for us is something new.

>>Right, a technique you were not familiar with.

>>A technique that we were not familiar with. And today we have become experienced and we do it with ease, as you can see.

>>And I see that this method is very convenient for you since you can produce much more lettuce much faster. Right?

>>Yes, an infinite variety of lettuce and in 2 months we have lettuce ready for the table,

>>Yes, And you can sell more

>>Yes, fresh, delicious lettuce that clients from Via el Salvador especially can consume and obtain great nutritional value.

>>Yes.

>>It's not the same as growing on soil, or traditional agriculture, which are not irrigated with boiled water, instead here we are very hygienic, and the lettuce is rich in nutrients and well taken care of.

>>And I imagine that you also consume it?

>>Yes, we consume it. In fact, we eat it everyday at home.

>>Sure.

>>It's very delicious and especially for hyperactive children it acts as a relaxant. A salad with egg and a potato, that's it. It calms them down.

>Ah, "papa a la Huancaína" very delicious.

>>Yes, delicious. I don't know how long you are staying but I'd like to invite you for some.

>>Yeah... that would be great. Thank you!

>>Papa a la Huancaína with lettuce. Yes, they are very delicious.

>>Yes, very delicious indeed. Well ma'am, thank you so much...

>>Wow, who knew you could grow so many vegetables with hydroponics? I'd like to give it a try someday. But before we go, let's just review a few of the things we can do to make sure we are successful in hydroponics. First, be sure to be exact with the proportions when you make your nutrient solution. Too much will burn the plants, and too little, well you get the picture. Next, remember the water-culture method is the best way to get a quick harvest of lettuce and other leafy greens. Also, remember that the medium you use for the aggregate system needs to be inert and capable of retaining moisture. And finally, be sure to stir the solution with an eggbeater two times a day, so the plants get all the oxygen they need. And that's all the time we have for today, but for more information on this and other episodes of HomeGrown, or to order a copy of the series, be sure to log onto HomeGrown at [www.byubroadcasting.org](http://www.byubroadcasting.org). Thank you for watching, and remember, everything is better HomeGrown! Goodbye.

>>On an upcoming episode of HomeGrown, we'll learn how to grow a square-foot garden. Since he first introduced the technique over 20 years ago, Mel Bartholomew has literally traveled the globe, teaching his revolutionary gardening system to millions of gardeners. We'll meet up with Mel and learn firsthand how to start our own square-foot garden. Be sure to check it out!

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