



Inter-American Institute for Cooperation on Agriculture

Hydroponic home-based vegetable production system MANUAL

by Dr. Héctor Muñoz



“The cultivation of plants without soil”

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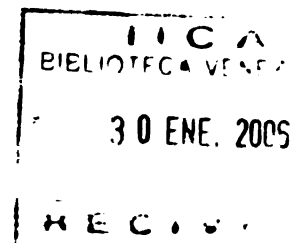
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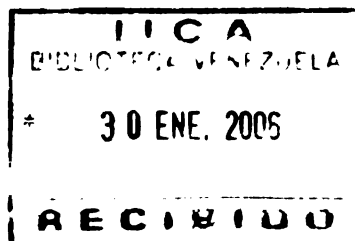
PREFACE

HYDROPONICS, the cultivation of plants without soil, is a technique of crop production which is most suitable for homeowners with limited resources, including finances, land space, water, time, materials and equipment.

This manual on Hydroponics provides, in very simple language, step-by-step instructions for the cultivation of a variety of crops. The Inter-American Institute for Cooperation on Agriculture (IICA), Office in Guyana, is pleased to provide producers with this alternative method of cultivation to assist in food security, improvement of household nutrition and also provide a means of improving incomes. Additionally, the information presented in this manual provides opportunities for family members to utilise free time which might otherwise be spent in unproductive or even destructive activities. It also allows for therapeutic and restorative treatment for geriatric and recovering family members and provides young children with a good start by engendering a positive attitude to farming.

Most importantly, the examples set out in this manual demonstrate a meaningful coincidence between production and environmental management. Materials which would normally have been thrown out and create environmental damage can now be utilised in a productive and beneficial manner.

It is our hope that extensive use is made of this manual and that it will contribute to production, consumption and marketing of wholesome products protecting the environment and ultimately to improving the welfare of homeowners with limited resources.



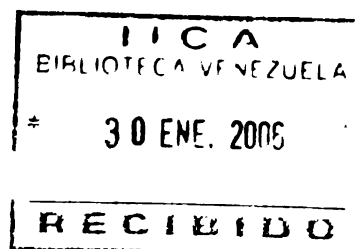
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INTRODUCTION

Hydroponics is often defined as "The cultivation of plants in water". Research has determined that many different aggregates or media will support plant growth; therefore, the definition of hydroponics has been broadened to read: *"The cultivation of plants without soil"*.

Hydroponic agriculture is a simple, clean and economical way of producing fast-growing, high-yield and generally protein rich plants that may be used for a balanced daily diet for families with low incomes. This agricultural technique is used in small urban spaces that are not appropriate for conventional cultivation methods.

Plants are developed and kept in inert or aggregate materials, that will support plant growth. The cost per crop is very low and nutrients are supplied through a solution that is applied daily.



OBJECTIVES

THE GENERAL OBJECTIVE OF HIDROPONICS

Hydroponics or "cultivation without soil" allows us, with a little dedication and care, to produce vegetables using small quantities of water, small unused spaces, little physical effort, making use of things we often throw away and the free time of some family members that is usually spent in activities that do not contribute to the overall welfare of the family unit.

THE MOST IMPORTANT SPECIFIC OBJECTIVES

- To improve the quality and quantity of the family's nutrition without increasing cost of living.
- To increase the family's income by decreasing expenditure and selling surplus production.
- To create work opportunities for members of the community; generate and promote positive attitudes towards community service.

- To support small industry, starting with the productive use of some of the family members' free time.
- To provide old age persons, or people with some kind of physical or mental disabilities the possibility of feeling useful and valuable to the family, the community and themselves.
- To promote an early interest in children towards activities that are useful for the family and promote a positive attitude towards group work, in communities characterized as being socially and economically marginalized.

PLACING OF THE HYDROPONIC GARDEN



Although you can place the garden almost anywhere in the house (walls, roofs, patios, windows, garage, etc.), there are some basic recommendations that must be taken into account in order to produce better crops:

- Heavily shaded, windy and extremely sunny spaces must be avoided
- It is suggested to keep the garden protected from domestic animals and pets.
- The space must receive a minimum of 6 hours of solar light.
- It must be close to a source of water.
- It must be close to the place where the nutrient solutions are prepared and kept.
- It must be kept far from trees and other plants that are affected by pests or diseases.
- It must be kept far from contaminated water.

SIZE OF THE HYDROPONIC GARDEN



Space is not an important factor in hydroponic gardening. A garden can be set up in spaces as small as 1 m². Most of the hydroponic gardens are any size between 10 to 20 m², but some families are able to keep gardens as big as 200 m². With a small space one may produce enough vegetables that will be nourishing and free of pollutants.



APPROPRIATE CONTAINERS FOR THE HYDROPONIC GARDEN

There are many types of containers that can be used or built depending on the space available around the house, the technical and economic possibilities and the needs of the specific family.

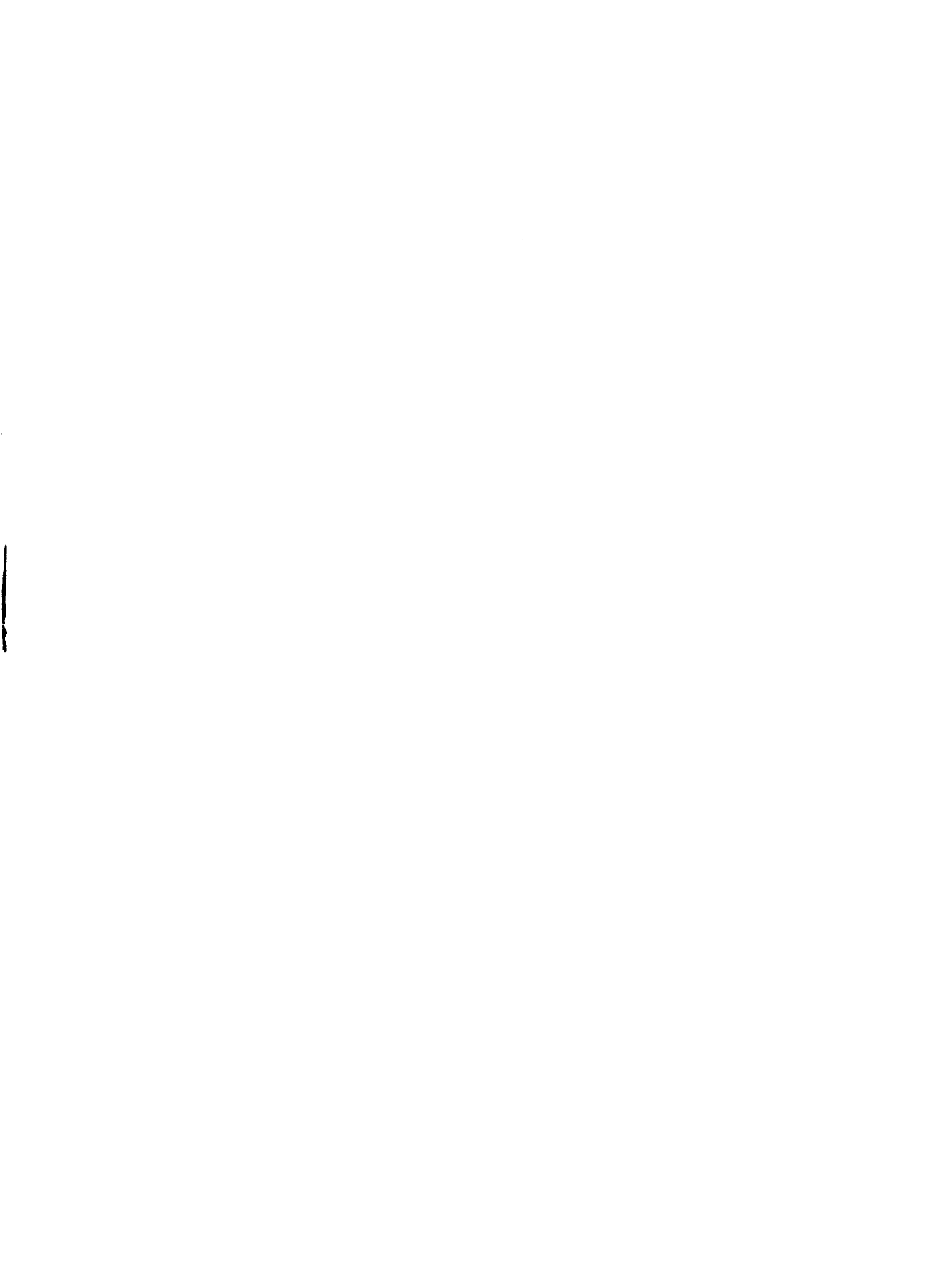


To start the garden and as a first step to acquiring the practical knowledge and basic skill, you can start with apple or grape boxes, old tyres, plastic washing tubs, one-gallon plastic containers or any container (not metal) with a minimum depth of 10 cm. You can also use plastic cups, oil containers, margarine containers, plastic soft drink bottles, which have enough space to plant lettuce, onions and parsley, among others.



The black plastic bags used in plant nurseries are cheap and easy to use and very good for small spaces for planting celery, basil, onions, lettuce, tomato and cucumber.





BUILDING A CONTAINER

If there is a need to build a container, you may consider building a box or bed with the following size:

- Length : 1.25 m
- Width : 0.95 m
- Depth : 0.10 m

The materials needed to build the box or bed are:

- Wood : 15' of 1x4" wood shingle or plank
- 166' of ½ x 3" wood shingle or plank
- Black plastic : 5.6'x 4.3'
- Nails : 1 lb 2"

The tools needed to build a bed are: Hammer, saw, meter rule, stapler, drill, drill bits, level, saran netting, water hose and water.



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THE SUBSTRATE

This is an inert material in which the roots of the plant will grow, and it may be either liquid or solid. The most common substrates in the tropical regions are:

- Sand
- Rice hulls or shells
- Clay bricks, ground
- Saw dust
- Volcanic stones, ground
- Water



The characteristics that a good substrate must have:

- It must be made of particles no longer than 7mm and no smaller than 2mm.
- It must be capable of maintaining moisture and draining excess water.
- It must not degrade or decompose easily.
- It must not hold microorganisms hazardous to human or plant health.
- It must not be contaminated with industrial residual waste.
- It must be abundant.
- It must be clean water.





Recommended substrate mixtures:

- 50 % rice hull:50 % ground volcanic stones
- 60 % rice hull:40 % sand
- 60 % rice hull:40 % ground clay bricks
- 80 % rice hull:20 % saw dust
- Clean rain water

Rice hulls:

These must be washed and kept very moist for 10 days in order that all seeds in the rice hulls will germinate. The germinated seedlings must be removed.

Saw dust:

Saw dust may be used in small quantities, 15 to 20 % of the substrate, since large quantities are harmful to some plants.

SOWING METHODS

Direct sowing:

Not every species needs to be planted in a seed bed. Some plants may be sown directly in the final growth place, some because they will not resist being transplanted and others because they grow enough and do not need special care during the first weeks.

Plants which can be sown directly:

Garlic bulbs	Radish
Carrot	Flowers
Peas	Zucchini
Green beans	Peanuts
Watermelon	Eschallot
Coriander	Oregano
Pumpkin	Watercress
Cucumber	Beans
Cantaloupe	Ochro

Plants that are reproduced using a part of the original plant (vegetative reproduction) are also planted directly. Strawberry, thyme, mint, beans, peas, cantaloupe, radish, watermelon and carrots may be planted using both methods.

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Indirect sowing:

Seed beds and transplanting:

This system is used with seeds that are very small or grow slowly, or are very fragile when they are just sprouting, for which they require special care that guarantees strong development to obtain



bountiful production. Most hydroponic plants are better off using this method. The seeds are planted on a seed bed or germinator with 5 cm between rows, 1 cm between seeds and 1 cm in depth.

Plants which require seed beds:

Onions

Chinese mustard

Tomato

Chinese cabbage

Peppers

Cabbage

Ornamental Plants

Beets

Cauliflower

Lettuce

Radish

Celery

Spinach

Fruit Plants

The time from germination to transplanting and harvesting depends on the vegetable species, as shown in the table below:

CROP	DAYS TO GERMINATE	DAYS TO TRANSPLANT	DAYS TO HARVESTING
Celery	12	18	40
Hot Pepper	8	18	50
Sweet pepper	12	15	80
Tomato	7	15	70
Lettuce	4	18	40
Parsley	12	18	55
Coriander	20		70

DRAINAGE

All containers to be used for substrate planting must have a drain through which excess water or nutrients are discarded. If the container is to be used for floating roots, it will not need a drain.

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NUTRIENTS AND FERTILIZERS

The hydroponic nutrients contain a balanced amount of nutrients to produce healthy and productive plants. In addition to the elements that vegetables extract from the air and water (carbon, hydrogen, oxygen), plants need some elements that may be classified by quantities needed:

Large	Intermediate	Small
Nitrogen	Sulphur	Iron
Phosphorus	Calcium	Manganese
Potassium	Magnesium	Zinc
		Boron
		Molybdenum

Preparation of nutrients for use:

La Molina Fertilizer Solution

A. Concentrated Solution of major nutrients:

<u>(for 10 litres of water)</u>	<u>kg</u>
Potassium nitrate	1.100
Ammonium nitrate	.700
Triple super phosphate	.350

B. Concentrated Solution of minor nutrients

<u>(for 5 litres of water)</u>	<u>kg</u>
Magnesium sulphate	.550
Iron quelate	.040
Magnesium chlorate	.005
Copper sulphate	.001
Boric acid	.003
Zinc sulphate	.002

For the use of these two concentrated nutrients two solutions will be prepared:

Solution A:

For every 1 L of water add 5 ml of major nutrients and 2 ml of minor nutrients.

Solution B:

For every 1 L of water add 2.5 ml of major nutrients and 1 ml of minor nutrients.

The use of solutions A and B:

How much to apply to plants:

2 L per m² during the wet season

3 L per m² during the dry season

100 ml for every plant

ECAG Hydroponic Fertilizer Solution		
For 4 Litres of water		
A. CONCENTRATED SOLUTION OF MAJOR NUTRIENTS		
		GRAMS
	Mono-potassic Phosphate	190.0
	Magnesium Sulfate	400.0
	Potassium Nitrate	440.0
B. CONCENTRATED SOLUTION OF MINOR NUTRIENTS		
		GRAMS
	Fertilon combo	20.0
	Boric acid	4.6
C. CONCENTRATED SOLUTION OF N C		
		GRAMS
	Calcium Nitrate	590
DOSAGE		
Solution		cc per 1 liter of water
A		5.0
B		2.5
C		5.0

When to apply to plants:

Six days a week, from 7 to 9 am, on the 7th day, apply only water.

Solution B: This solution is used only for plants that were transplanted and plants in the seedbed after sprouting, from day 0 until day 7.

PESTS

For the control of pests, we may use natural products such as pepper, garlic and tomato. These have the following advantages:

- They are non-pollutant
- They don't cause pest resistance
- No special equipment is necessary to fumigate
- Easily made
- Economical

Preparation:



Pepper:

- Grind 3 ounces of pepper and add water.
- Let stand overnight, strain and mix with 5 L of soapy water.
- Apply daily.
- Controls: ants, worms, fleas, flies, chewers.



Garlic:

- Mix 3 ounces garlic with oil and let stand for 24 hr.
- Dissolve 10 g of soap in 1 L of water. Mix and strain and add 20 L of water.
- It may be used as repellent, pesticide, bactericide, fungicide and nematicide.



Tomato:

- Grind leaves and stems.
- Boil in 4 bottles of water for 10 min.
- Let it cool and apply.
- Controls: Fleas, lice and hairy worms.
- Do not apply on plants of the same family, such pepper and eggplant.



Tomato

- Good source of lycopene
- Boil in 4 bottles of water for 10 min.
- Let it cool and apply
- Controls: Fever, flu and body aches
- Do not apply on areas of the same flesh, such as pitted and
scalded