

# *Hydroponics Photo Album*

*Dr. Howard M. Resh*

# *Greenhouses & Components*



**Hydronov, Inc. Mirabel, Quebec, Canada. Growers of lettuce with raft (deep water floating) culture.**

*(Photo courtesy of Hydronov, Inc., Mirabel, Canada.)*



**Houweling Nurseries Oxnard, Inc. The principal crop is tomatoes-on-vine (TOV).  
Glasshouses of Venlo style.**

*(Courtesy of Houweling Nurseries Oxnard, Inc, Camarillo, CA.)*





**Four acres of solar photovoltaic system with water-retention pond below.**

*(Courtesy of Houweling Nurseries Oxnard, Inc., Camarillo, CA.)*





**500,000-gallon, hot-water storage tank. Water is heated by the boilers during the day to generate carbon dioxide for enriching the greenhouse atmosphere as a by-product of burning natural gas. The hot water is stored in the large tanks to be re-circulated back through the greenhouse at night for heating.**

*(Courtesy of Gipaanda Greenhouses Ltd, Delta, B.C., Canada.)*



**Carbon dioxide recovery system that takes the cleaned gas from the boiler to the greenhouse for carbon dioxide enrichment of the atmosphere.**

*(Courtesy of Bionatur Invernaderos Biologicos De Mexico, S.A. De C.V., Jocotitlan, Mexico.)*



**Nutrient solution make up area with stock solutions and injection system.**

*(Courtesy of Ko Welleman, The Netherlands.)*





**Water storage tanks.**

*(Courtesy of Ko Welleman, The Netherlands.)*

## *Picking & Packing*



**Bins for harvesting peppers and cucumbers travel on a chain track system.**

*(Courtesy of FormFlex/Metazet Zwethove B.V., The Netherlands.)*



**Carts move tomatoes-on-vine (TOV) from the greenhouse central passageway on a chain track system to the packing facility.**

*(Courtesy of FormFlex/Metazet Zwethove B.V., The Netherlands.)*





**Peppers are transported from the chain track carts to a belt that takes them to the packing-grading facility.**

*(Courtesy of FormFlex/Metazet Zwethove B.V., The Netherlands.)*

# *Tomatoes*



**Tomato transplants at 5 to 6 weeks of age in coco coir blocks. These are Jiffy blocks each having two plants. This is an ebb-and-flood system in which the nutrient solution floods the blocks from the bottom and then drains back through the drain holes in the center. The stakes in the blocks are to support the plants.**

*(Courtesy of Jiffy Products.)*



**Receptive tomato flowers ready for pollination.**





**Receptive tomato flower.**



**Fruit set of tomatoes.**

*(Courtesy of Krista E. Loomis & McWethy Farms, Three Oaks, MI.)*



**Various Heirloom tomatoes.**

*(Courtesy of Todd McWethy, McWethy Farms, Three Oaks, MI.)*





**Trusses of cherry tomatoes.**





**Truss of Zebrina cherry tomato.**



**Tomatos-on-vines (TOV) ready to harvest. Plants are growing in rockwool slabs on raised beds. Heating pipes run down the center of the aisle.**

*(Courtesy of Houweling Nurseries Oxnard, Inc., Camarillo, CA.)*





**View of tomato crop from above. This is the new 40-acre range of Houweling Nurseries Oxnard, Inc. in Camarillo, California. These greenhouses have 7 meter or 23 ft sidewalls (gutter height) to allow optimum air circulation. The large space above the crop permits good air flow. The tomahooks with the string wound on them are for lowering the plants.**

*(Courtesy of Houweling Nurseries Oxnard, Inc., Camarillo, CA.)*



**Cherry tomatoes growing in Bato Buckets of perlite. The long stems on top of the pots are from lowering and leaning the plants from above with the support strings.**

**(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)**





**Cherry tomatoes ready to harvest growing in perlite culture.**





**Packaging of beefsteak tomatoes.**

*(Courtesy of Houweling Nurseries Oxnard, Inc., Camarillo, CA.)*



**Packaging of beefsteak tomatoes for appealing presentation.**

*(Courtesy of Todd McWethy, McWethy Farms, Three Oaks, MI.)*



**Heirloom tomatoes.**

*(Courtesy of Todd McWethy, McWethy Farms, Three Oaks, MI.)*



## *Peppers*



**Receptive pepper flower.**



**Red bell peppers ready to harvest. Plants are growing in the Bato Bucket perlite system.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Red bell peppers ready to harvest.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**“Fireflame” hot peppers.**



**Yellow bell peppers ready to harvest.**





**Cubanelle peppers growing in perlite culture in plant towers.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Yellow Bell Pepper.**





**Various bell peppers.**

## *European Cucumbers*



**Young European cucumber seedlings 7 days old growing in rockwool cubes are ready to be transplanted to rockwool blocks.**

*(Courtesy of CuisinArt Resort & Spa, Anguilla, B.W.I.)*





**Female flower of European cucumber. European cucumbers are female only plants.**

**(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)**



**Mature European cucumbers growing in perlite ready to harvest 6 weeks after sowing.**  
*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Guttation of cucumber leaf. This occurs in the early morning under high relative humidity conditions and high plant root pressure. Special structures called hydathodes located at the leaf margins permit excess water accumulating in the leaves to escape forming water droplets. It is important to ventilate to dry out these water droplets as they can facilitate fungal infection entry to the plant.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*

# *Eggplants*



**Eggplants, variety “Taurus”, growing in Bato Bucket perlite system. Note the drip lines to each plant. The seeds are sown in rockwool cubes and later transplanted within 3 weeks to rockwool blocks. The seedlings are transplanted to the Bato Buckets about 5 to 6 weeks after sowing. These lower fruit are ready to harvest after 3 months from sowing.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Mature eggplant ready to harvest.**





**Mini eggplant, variety “Fairy Tale” growing in perlite of plant towers.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**High quality eggplants ready for market.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*

## *Lettuce*



**Lettuce seedlings in rockwool cubes 18 days old ready to transplant.**





**Lettuce 26 days after transplanting in raft culture ready to harvest. Note the white, healthy roots. They are supported by Styrofoam boards.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Rows of lettuce showing sequence of planting dates to reduce mutual shading. This is a moveable tape NFT system to allow automation of transplanting and harvesting.**

*(Courtesy of F.W. Armstrong Ranch, Oak View, CA.)*





**Lettuce seedlings 3 to 4 weeks old entering the extended nursery area where they will be grown for up to 2 weeks before transplanting to the nutrient film technique (NFT) gutters. This is part of Hortiplan's Mobile Gutter System (MGS).**

*(Courtesy of Hortiplan N.V., Belgium.)*





**Lettuce seedlings 5 to 6 weeks old entering the MGS.**

*(Courtesy of Hortiplan N.V., Belgium.)*



**Oakleaf lettuce ready to harvest growing in the MGS. Note the use of supplementary lighting to extend the daylength and provide additional light as this was in the winter.**

*(Courtesy of Hortiplan N.V., Belgium.)*





**Lollo Rossa lettuce ready to harvest growing in the MGS.**

*(Courtesy of Hortiplan N.V., Belgium.)*





**Trio lettuce (3 plants per block: red oakleaf + Lollo Rossa + Lollo Bionda) in MGS.**

*(Courtesy of Hortiplan N.V., Belgium.)*



**Bibb lettuce in MGS.**

*(Courtesy of Hortiplan N.V., Belgium.)*





**NFT gutters of the MGS travel on a belt to the packing area of the greenhouse. They are moistened to keep them fresh before packaging.**

*(Courtesy of Hortiplan N.V., Belgium.)*





**Leaf lettuce growing in raft (deep water) culture. The greenhouse bays measure 500 ft x 21.5 ft. Hydronov, Inc., claims production levels up to 500 head (150 gm/head) of lettuce per square meter (10.76 sq ft) per year. It takes about 45 days per crop with 20 crops annually. They compare that to annual production of 36 plants/square meter in field production.**

*(Courtesy of Hydronov, Inc., Hydroserre Mirabel Inc., Mirabel, Quebec, Canada.)*





**Bibb lettuce in raft culture system.**

*(Courtesy of Hydronov, Inc., Hydroserre Mirabel Inc., Mirabel, Quebec, Canada.)*



**Lettuce at 7 weeks ready to harvest growing in NFT system of A-Frames. The use of A-Frames is to increase production for the area of greenhouse space occupied.**

*(Courtesy of Grupo Tecnico Aponte, Bogota, Colombia.)*





**Three tier lettuce moveable tape NFT system.**

# *Arugula*



**Arugula growing in NFT system in Brazil.**

*(Courtesy of Hidroponia Mandala, Brazil.)*





**Arugula in peatlite soilless system. This arugula may be harvested three times.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



## *Bok Choy & Chard*



**Green & Red Bok Choy in NFT system.**

*(Courtesy of Lauren Rathmell & Lufa Farms, Montreal, Quebec, Canada.)*





**Red Chard in NFT system.**

*(Courtesy of Lauren Rathmell & Lufa Farms, Montreal, Quebec, Canada.)*





**Bok Choy “Green Fortune” in plant towers with perlite substrate.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Bok Choy “Takuchoi” in plant tower of perlite medium.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



## *Herbs*



**Regular chives in perlite 24 days after sowing.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Herbs 24 days from sowing in perlite culture in plant towers. From front to back: Italian parsley, moss parsley, oregano, garlic chives, regular chives, thyme, sweet marjoram, sage, spearmint.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**In plant towers with perlite substrate: left to right: spearmint, sage, sweet marjoram, thyme, regular chives, garlic chives.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Herbs in plant towers. From front to back: Italian parsley, moss parsley, oregano, garlic chives, regular chives, thyme, sweet marjoram sage, spearmint.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Mint growing in beds of rice hulls.**

*(Courtesy of California Watercress, Inc., Fillmore, CA.)*





**Sweet basil in NFT system.**

*(Courtesy of American Hydroponics, Arcata, CA.)*

# *Watercress*



**Watercress in modified NFT beds 9 feet wide by 600 ft long.**

*(Courtesy of California Watercress, Inc., Fillmore, CA.)*





**Watercress in ebb & flood beds 6 feet by 20 to 25 feet.**

*(Courtesy of Hidroponias Venezolanas, S.A., Caracas, Venezuela.)*



**Watercress and lettuce at several terraces with ebb & flood system. The lettuce grows in sand culture and the watercress in a water culture system of ebb & flood.**

*(Courtesy of Hidroponias Venezolanas, S.A., Caracas, Venezuela.)*



# *Microgreens*



**Plastic flats (trays) with microgreens growing in a capillary mat (STG mat). These are watered by hand once a day and are ideal for growing in one's home. The microgreens are 10 days old and ready to harvest. Lettuce mix on left and amaranth on the right.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Lettuce mix on the left and amaranth on the right. Amaranth is very high in the anthocyanin pigment similar to beets and is very nutritious in iron. Harvest the shoots of the microgreens with a scissors cutting them above the capillary mat.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**“Allgreens” microgreens 6 days old ready for harvest.**

***(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)***



**Several Purple radishes 6 days old ready to harvest.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*





**Amaranth 12 days old ready to harvest.**

*(Courtesy of CuisinArt Resort & Spa, Hydroponic Farm, Anguilla, B.W.I.)*



**Alfalfa sprouts in a series of racks with automatic irrigation by mist nozzles. These sprouts are three days old. The cropping cycle is four to five days from sowing.**

*(Courtesy of Hidroponias Venezolanas, S.A., Caracas, Venezuela.)*



# *Strawberries*



**Strawberries in coco coir sitting on raised trays.**

*(Courtesy of Jiffy Products.)*



**Strawberries growing outside in plastic sacks of rice hulls and coal ash (escoria). This is in the tropical climate near Bogota, Colombia so no greenhouses are needed.**

*(Courtesy of Fresex, Bogota, Colombia.)*



# *Rooftop Hydroponic Farms*



**Hydroponic rooftop greenhouse 31,000 square feet. Crops include tomatoes, peppers, cucumbers, eggplants, lettuce, arugula, bok choy, basil, salad mixes, and herbs. The vine crops use coco coir slabs on raised trays. The lettuce, bok choy, chard, arugula, and basil are in NFT. The herbs and salad mixes in ebb-and-flood systems. All products are sold directly to the end user through a community supported agriculture (CSA) network.**

*(Courtesy of Lauren Rathmell & Lufa Farms, Montreal, Quebec, Canada.)*



**Gotham Greens greenhouse in center with solar array in the foreground. The greenhouse located in Brooklyn, NY, is 12,000 square feet on top of a two-storey industrial building. They grow lettuce and basil in NFT and market to high-quality supermarkets.**

*(Courtesy of Ari Burling & Gotham Greens, Brooklyn, NY.)*





**The Science Barge is a sustainable urban farm designed by New York Sun Works. The floating barge contains a hydroponic greenhouse powered by solar, wind and biofuels. The farm grows tomatoes, cucumbers, and peppers in Bato Buckets of perlite and lettuce and herbs in NFT. They have a public education program with school groups and the general public.**

*(Courtesy of Manuela Zamora & New York Sun Works, New York, NY.)*

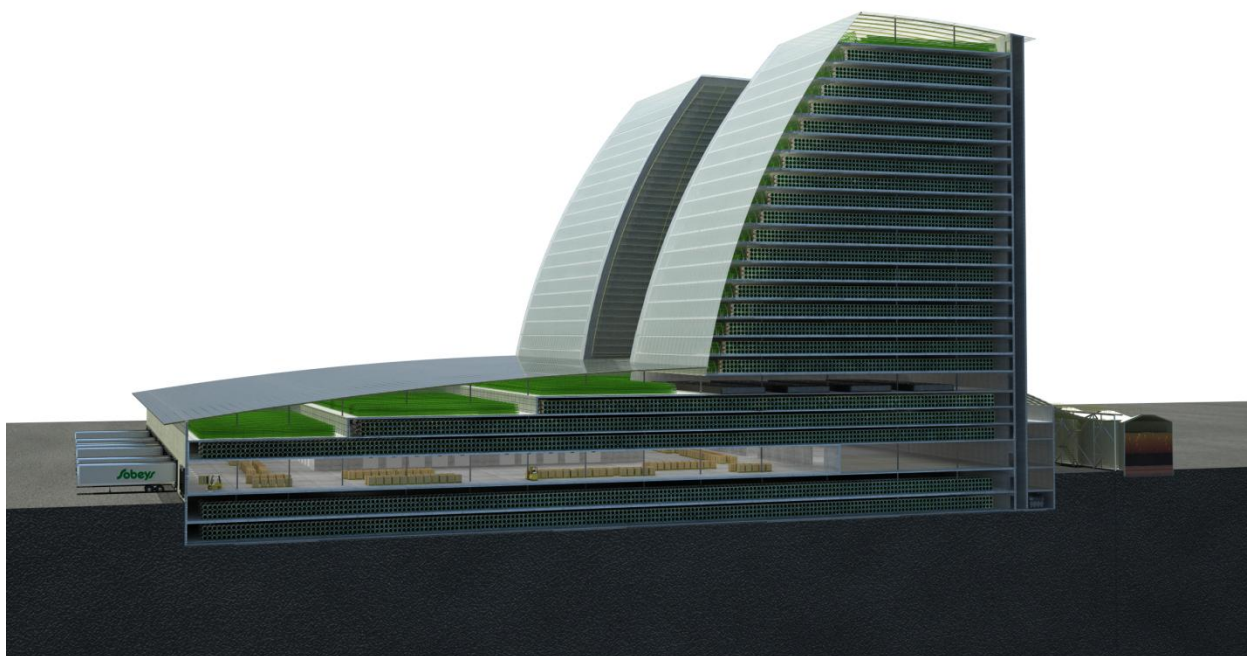
# *Vertical High-rise Greenhouses*



**Conceptual design of a hydroponic farm attached to office buildings and/or residences.**

*(Courtesy of Gordon Graff, Agro-Arcology, Toronto, Canada.)*





**A conceptual design of a vertical greenhouse**

*(Courtesy of Gordon Graff, Agro-Arcology, Toronto, Canada.)*

# *Automated Vertical Hydroponic System*

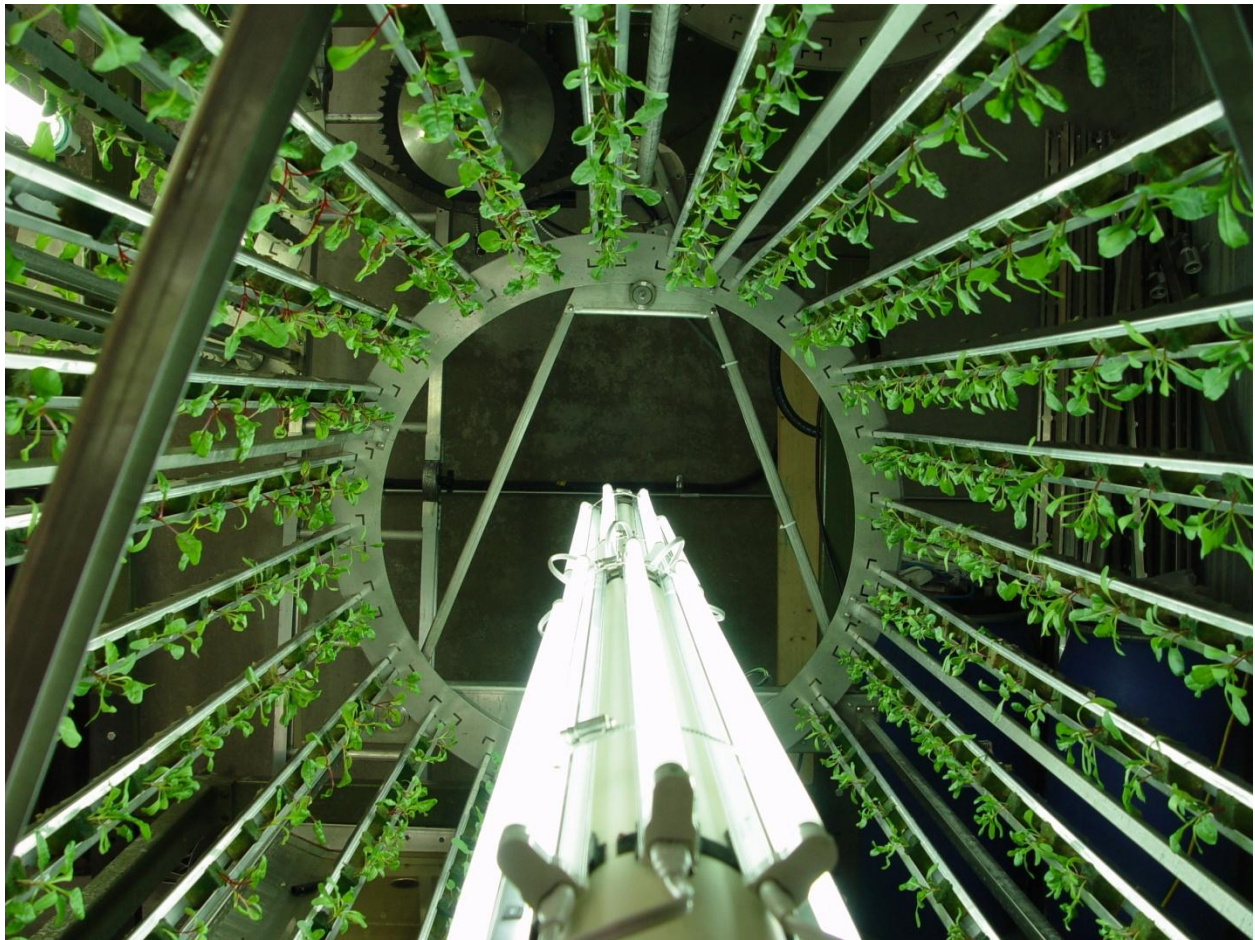


**Vertical automated growing system. There are 8 levels of trays stacked to about 10 feet tall. The system has an automated irrigation system on one side where the trays are irrigated as they pass in front of the spray nozzles. Use of the greenhouse floor area is increased by the conveyor system curving back and forth in a serpentine fashion**

*(Courtesy of Valcent Products (EU) Ltd., Cornwall, UK.)*



## *Omega Garden Automated Rotating Drum*



**Omega Gardens rotating drum with young chard plants. Nutrient solution from a reservoir at the bottom is sprayed on the plant roots as the channels holding the plants pass above at each circulation of the drum. Young chard plants are in the drum.**

*(Courtesy of Omega Garden, Int., Vancouver, Canada.)*



**Chard growing in the rotating Omega drum.**

*(Courtesy of Omega Garden, Int., Vancouver, Canada.)*





**Omega Garden single carousel growing sweet basil. Note the orientation of the plants toward the central light.**

*(Courtesy of Omega Garden, Int., Vancouver, Canada.)*

# *Resort Hydroponic Farm*



**View of villas on the beach of the CuisinArt Resort & Spa in Anguilla.**

*(Courtesy of CuisinArt Resort & Spa, Anguilla, B.W.I.)*





**View of the villas and the main hotel in the center. Beautiful white sand and blue waters of the beach.**

*(Courtesy of CuisinArt Resort & Spa, Anguilla, B.W.I.)*



**Hydroponic farm of 18,000 square feet at the CuisinArt Resort & Spa in Anguilla. The farm grows tomatoes, peppers, European cucumbers and eggplants in a Bato Bucket perlite system. Lettuce is in NFT. Basils, other lettuces, and arugula in a peatlite mix substrate. Herbs and bok choy is in plant towers of perlite culture.**

*(Courtesy of CuisinArt Resort & Spa, Anguilla, B.W.I.)*



## *Personal Photos of Dr. Resh & Colleagues*



**In San Jose, Costa Rica, left to right: Howard Resh, Alfredo Rodriguez Delfin-Universidad Nacional Agraria La Molina, Lima, Peru; Miguel Urrestarazu Gavilan-Universidad de Almeria, Almeria, Spain; Carlos Arano, Buenos Aires, Argentina; Pedro Roberto Furlani-State University of Campinas, Campinas, Brazil.**



**Third Congreso Internacional De Hidroponia, April 13-16, 2011 in Costa Rica.**  
**Participants include from left to right: Alejandro Aponte, unidentified course member, Alfonso Aponte-Hortalizas Biologicals, Bogota, Colombia; Laura Perez-Centro Nacional de Jardineria Corazon Verde, Costa Rica, organizer of the conference; Andrea Perez, organization assistant; Miguel Urrestarazu Gavilan-University of Almeria, Spain; Gloria Samperio Ruiz-President, Asociacion Hidroponica Mexicana, Toluca, Mexico; Alfredo Rodriguez Delfin-Universidad Nacional Agraria La Molina, Lima, Peru; Howard Resh.**





**Alfredo Rodriguez Delfin & Howard Resh in Lima, Peru-August 2011.**



**12<sup>th</sup> Curso Practico International De Hidroponia, August 8-11, 2011, Lima, Peru. Course instructors: front row from right to left-Alfredo Rodrigues Delfin, Milagros Chang, Paola Palacios, Carlos Chuquillanqui, Antonio Quispe (kneeling) and Howard Resh, behind Milagros, and students. The course was held at the Centro de Investigacion de Hidroponia, Universidad Nacional Agraria La Molina, Lima, Peru.**



*Thank you, wishing you successful  
hydroponic growing*

