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Canadian R&D will be a catalyst for change as …

Greenhouse Aquaponics Proves Superior to Inorganic Hydroponics

By Geoff Wilson

Aquaponic technology for growing food plants in greenhouses is significantly superior to inorganic hydroponics.

This is the startling conclusion reported at the International Conference and Exhibition for Soilless Culture-2005 in Singapore from September 5 to 8.

I expect it to trigger a cascade of global interest in aquaponic technology. The report was made by Dr. Nick Savidov, of the Crop Diversification Center South, Alberta Agriculture Food and Rural Development at Brooks, Alberta, Canada.

It followed two years research at Brooks comparing greenhouse growing of plants under both aquaponic and inorganic hydroponic regimes (see report in "Aquaponics Journal," 2nd Quarter, 2005).

A major collaborator in the project was Dr. James Rakocy of the Agriculture Experiment Station of the University of Virgin Islands, who is the acknowledged world leader in freshwater aquaponics science and technology.

The accompanying bar charts on the following page well sum up Dr. Savidov's report to the Singapore conference.

The first shows that aquaponics, before it has fully developed its all-important microbiology to convert fish wastes to plant food, is not as productive in greenhouse growing of food plants as inorganic hydroponics.

But, when the aquaponic system is fully operational after six months, it leaps ahead of inorganic hydroponics. This leads to earlier maturity of greenhouse crops under aquaponics and much heavier cropping.

The result is expected to be a revenue advantage for greenhouse growers in temperate or cold climates taking up aquaponics to gain higher prices from early markets for seasonal fresh produce. At present, they face heavy competition in this from growers in warmer climates.

The economics of investment in expensive greenhouses in colder climates will also be improved from the greater productivity. A very real bonus will be additional revenues from sales of fish.

Dr. Savidov's report at the Singapore conference led to almost heated exchanges with fellow scientists specialising in inorganic hydroponics. They even questioned his inorganic nutrient choices and tried to undermine aquaponics as a possible problem technology from human disease transfer or as a snail parasite source (one of the major points in favor of inorganic hydroponics in some countries is that it breaks the water-borne disease or parasite cycle).

On all counts, Dr. Savidov and other aquaponic experts at the Singapore conference, made effective rebuttals.

Dr. Nick Savidov, Crop Diversification Center South, Alberta, Canada

Dr Savidov, a researcher for 20 years in inorganic hydroponics, said he, too, was surprised by the results of the aquaponic-hydroponic comparison. It has led him to double-check the hydroponic nutrients used, and the data.

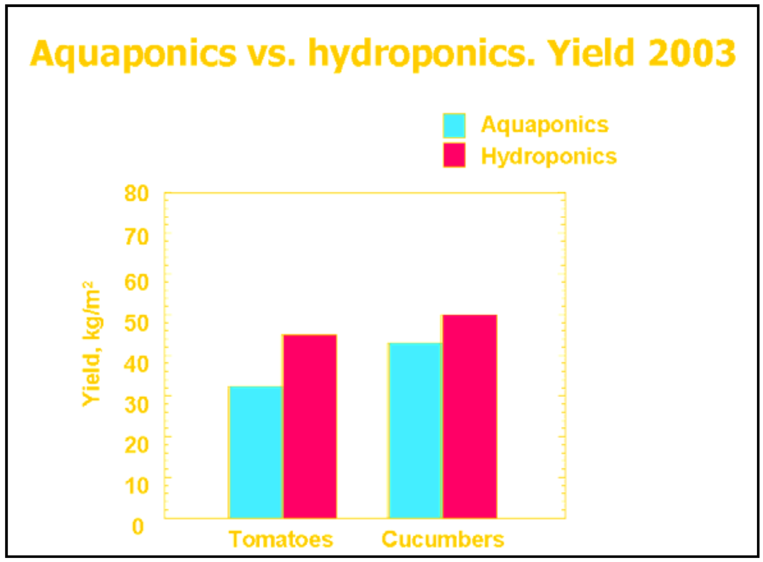
Dr. James Rakocy from the University of Virgin Islands, testified that, in 25 years of UVI aquaponic production using fish wastes to grow fresh vegetables for local consumption, not one disease or parasite incident had occurred. In either case it was a groundless fear if precautions were adequate.

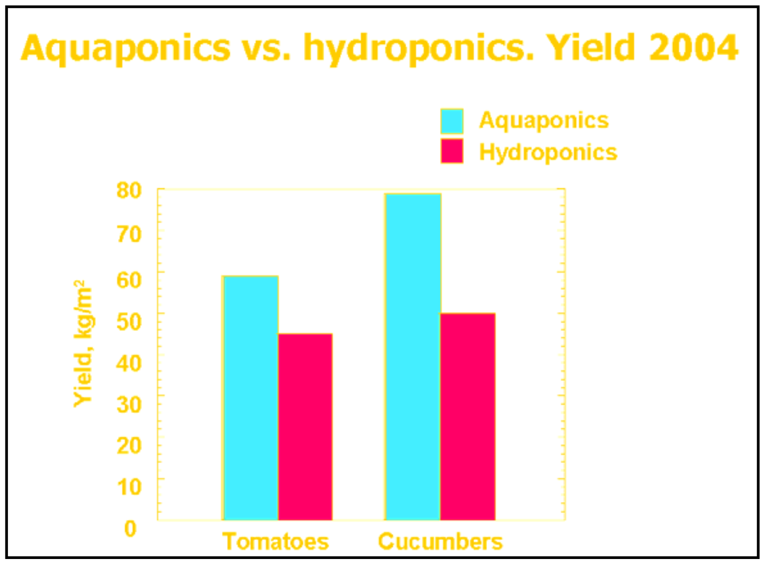
I was also able to testify that Australia's seven-year experience with aquaponic production had not revealed any human disease or parasite problems. Indeed, the aquaponic growers had the advantage of the healthy "organic" cachet for their produce.

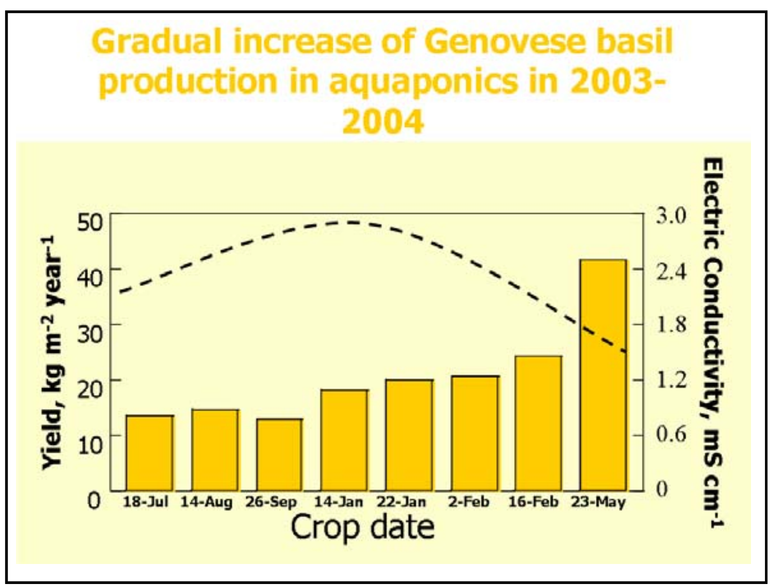
Dr. Savidov said the "unknown growth factor" in aquaponic production was worthy of further research, not only to better understand aquaponic technology, but also to see if use of the "unknown growth factor" could be applied to improve inorganic hydroponic production in greenhouses.

More than 60 different food crops and varieties have been tested in the Alberta greenhouse and 24 were chosen for trials on production levels. Five were greenhouse vegetables and 19 were herbs. The pictures on pages 16 and 17 tell the story better than any words.

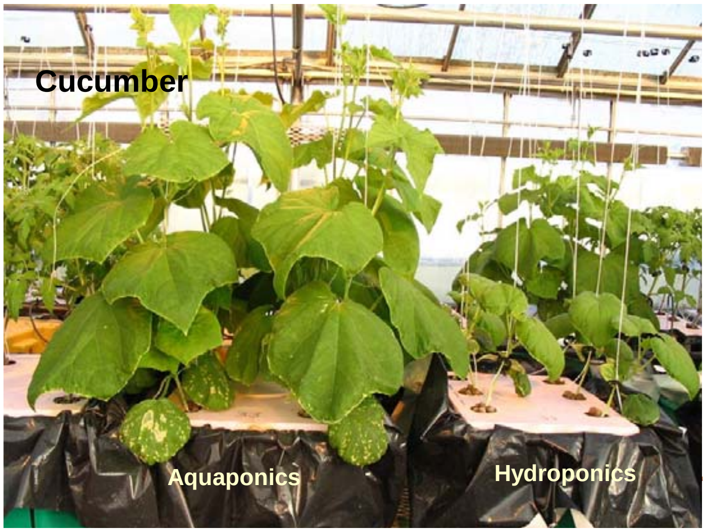
An economic feasibility study is now under way, Dr. Savidov said. It can be expected to be of







Above: Results of Aquaponic/Hydroponic production comparisons, 2003-2004 major interest to the world's growers of greenhouse plants, because of the likely revenue benefits and because aquaponics solves one of the major problems of inorganic hydroponics in greenhouse production.



Comparison of cucumbers: plants on the left were grown in aquaponics and the plants on the right were grown in hydroponics.

This is disposal of waste waters still containing nutrients. It has become a rising cost that has bedevilled greenhouse growers in Europe and North America, where increasingly-stringent waste disposal regulations are being applied. In aquaponics there is only sludge residue for disposal from the fish wastes as they pass through to organic hydroponic growing of plants.

The plant-growing cleans the water so it can be returned for re-use in fish tanks. In this way the aquaponic technology is an even more miserly water user than inorganic hydroponics – a point which will become increasingly important in a world where climate change problems may make traditional food production technologies in soil either uneconomic or difficult.

Also, most relevant is the rising cost of inorganic nutrients for hydroponics, because many are wedded to heavy use of petroleum energy – whereas fish farming (especially when using herbivorous or omnivorous fish species) is able to take advantage of most desirable recycling of urban and rural organic matter (via worm farming).

Of course, as Dr. Rakocy rightly points out: "Fish feed is very well formulated and contains corn, soybeans, fish meal, vitamins and minerals. An aquaponic system using urban and rural organic matter would currently not lead to good fish growth and may not generate adequate nutrients for plants."

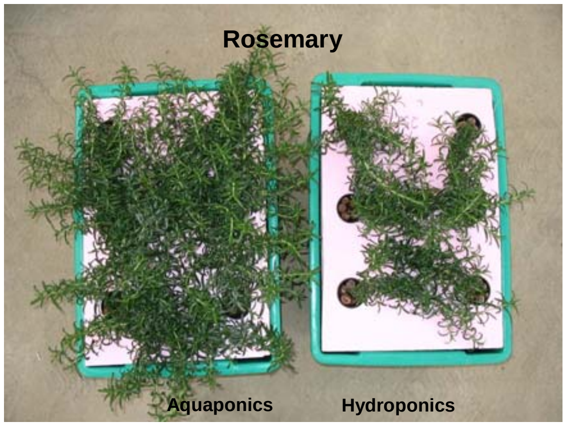
That is a direction for future research into the refinement of the aquaponic technology.

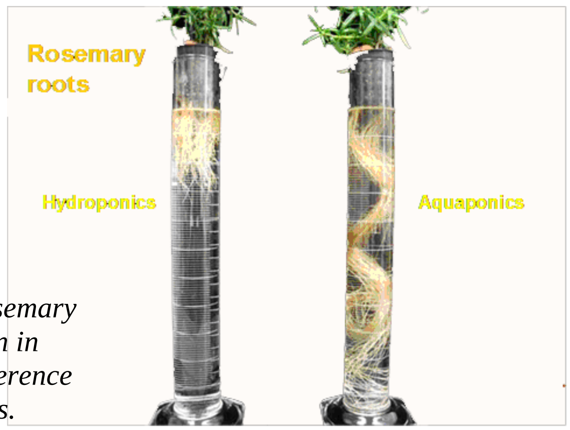
Conclusions Reported by Dr. Savidov in Singapore:

1. The study demonstrated that the Rakocy (UVI) aquaponics model developed for outdoor conditions can be successfully adapted for greenhouse operations in Canada.
2. The same yields of vegetables as in hydroponics are achievable using aquaponics technology.
3. The rate of fish biomass production in aquaponics is comparable with conventional aquaculture operations
4. The aquaponics system has an intrinsic capacity of self-regulation and balancing nutrients in the solution.
5. The nutrient balance necessary for optimal crop production can be reached within six months of operation or earlier.
6. Biological control is an essential tool for success of aquaponics operations
7. Staggered crop and fish production and maintenance schedules prevent spikes in nutrient concentrations.
8. Economic analysis is under way. However, a preliminary estimation indicates that aquaponic operations are economically feasible when growing high value crops like basil.

Thus, economic and environmental advantages of aquaponics (now mostly a partly-organic system that can be improved upon to become totally organic) over inorganic hydroponics can be seen as having just begun to be revealed by the recent greenhouse research in Canada and the continuing development of the technology in the United States and Australia.

The next major step for aquaponics research, in my view, is to demonstrate its urban agriculture and urban aquaculture variations that put food production close to where it is needed





Photos to right: comparison of rosemary grown in aquaponics and grown in hydroponics. Note the drastic difference in plant size and the root mass.

– without transport cost and all that means reduced use of fossil fuels and resulting in reduced air pollution.

The Canadian greenhouse research milestone is, therefore, likely to be an important global catalyst for many kinds of changes in our food production paradigms.

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