The debate on "Organics" and "Hydroponics"

There is a huge popular debate about the value of "organic" fertilizers and methods, many people would like to apply "organics" to hydroponics. Currently accepted organic fertilizer components are dependent upon organisms in the soil to convert the "organic" materials into a useable form for plants.

In hydroponics we provide the minerals required for plant growth directly, completely eliminating the need for soil and soil-organisms. The result is much higher growth rates, yields and even crop quality than organic methods can achieve. This is not what some people want to hear, but it is the simple scientific truth - and practically all scientists and educators in the fields of agriculture and chemistry know it and will be the first to agree. In fact, the kinds of materials which are permitted for use under "organic" regulations are not of sufficient purity to be used for hydroponic culture.

With this in mind it's important to recognize the reasons that "organically" grown produce is gaining such popularity. Consumers want to buy produce which is not tainted with hazardous chemicals or poisons. There is an increasing public demand for methods which are gentle on our delicate planet and which don't harm the soil, water or ecosystems. Hydroponic farming methods fit properly into this system of values if used appropriately. Hydroponics protects soil because it doesn't use soil. Less water is required for hydroponic culture and consequently more food can be cultivated with less water. The fertilizers we use for hydroponics are ultra-pure and leave no residue in the cultivated fruits and vegetables. Since hydroponic technologies are more efficient than soil methods, more people can be fed with less area and ecological impact.

THE ORGANIC HYDROPONIC DEBATE OPENING PANDORA'S BOX
As seen in the Growing Edge Magazine

During the 1980’s, Americans increasingly became more health-conscious. Cholesterol was ruled out and exercise became a part of

our daily routines. Today this still holds true, but even more so. What we put into our bodies is carefully scrutinized, even our fruits and vegetables, which has made “organic” a buzzword of the ‘90s. People are buying organic skin care products, “organic shampoos” and even "organic clothing”. Everybody seems to want “organic” and hydroponic growers are quite aware of this. Why, then, are there hardly any "Certified Organic hydroponic growers” in the United States? Many go through a great deal of trouble to grow their crops "organically," but even though they follow most guidelines, they still cannot get the recognition or certification necessary to sell their produce to most restaurants or natural food stores as “organic”. What is it that is separating organic from hydroponic methods? Why can't these two technologies work together under today's American states' certification guidelines?

WHAT'S ORGANIC, WHAT'S NOT?

We would think that this is an easy question to answer, but it isn't. In the United States there are numerous different definitions of "organic", many of which differ significantly. Each state has its own regulations for labeling produce as “organic". Additionally, there are 36 non-governmental organizations which can certify" produce as organic. For example, California growers who wish to sell their produce as "organic" must register with the California Department of Food and Agriculture and pass their inspection. However, California grower's can also obtain certification through the California Certified Organic Farmers (CCOF), which actually has higher standards for organic than the state has.

The CCOF certification is optional, but produce with California state registration and CCOF certification may be offered for sale within the state as "certified organic" If the grower chooses not to seek CCOF certification, the produce can be offered for sale in California as "organic," but not "certified organic”. Any produce grown outside of the United States can be sold as "certified organic" in the country if one of the 36 non-governmental organizations certifies it. In fact, produce from any state can be granted certification from one of the non-governmental organizations, even if it does not meet the organic standards for the state in which it is being sold. Pretty confusing!

What this all means is that the "organic" label is a matter of bureaucratic definitions, which can vary from state to state, and country to country.

In order to bring some kind of standard into play, the U.S. Department of Agriculture (USDA) – along with state government regulators, non-governmental certifiers, consumers, industry interest groups, food processors and various special interest groups – is writing a federally mandated set of "organic" standards. No state will be able to apply more stringent standards than those of the federal. Sometime this spring, the federal standards will be released for a 90 day comment and review period, and by the end of 1996 or early 1997, these standards will become law, or "Frankenlaw"; we'll have to wait and see.

The basic objectives of "organic" practice include the following:

- Avoidance of pesticides, by use of natural pest controls (also applied by many hydroponics growers).
- Caring for soil by recording nutrients and composting, and
- Moderation of nutrient application with reliance on the buffer action of humus derived from compost.

Soilless hydroponic cultivation moderates nutrient supply by the more exact measurements of soluble nutrient formulations, mixed to meet the optimum requirements of each plant species and growth phase. Many consumers select "organic" produce, believing that this is the only way to be assured of pesticide-free non—hazardous food. While "organic" farming methods do produce crops generally superior to and safer than those grown by agri-business practices, modern hydroponic techniques can put forth equally safe food that in many cases offers advances in nutrition and taste over their soil-grown “organic” counterparts. But to the consumer, it's the label that counts, so an increasing number of growers throughout the United States are struggling to get organic certification in any way, shape or form.

Meanwhile, this whole situation poses an enormous dilemma to hydroponic growers who also want organic recognition for their produce. The primary problem for organic hydroponic growers is

in the formulation of the soilless nutrient solution. A secondary issue, which concerns the federal regulators, is in the way used hydroponic nutrient and media such as rockwool are disposed of. Since "organic" is to a large extent a farming philosophy in support of a healthy environment, the federal concern is entirely reasonable.

Although the latter factor has no bearing on the quality and safety of the produce itself, the impact upon the planet is a real driving force behind the issue of "organic" farming. If hydroponic growers can find a way to completely recycle exhausted water, nutrients and media, then the argument in favor of "organic-hydroponic certification" becomes much stronger, but there's still the issue of formulating a satisfactory organic hydroponic nutrient mix. Organic nutrient regulations prohibit the use of many mineral salts and highly refined substances, including food and pharmaceutical grade ingredients that are extremely important for successful hydroponic nutrient formulation.

Only unrefined minerals can be used on "organic" crops and these often don't dissolve well or contain quantities of impurities, some of which are even relatively toxic but are "natural" and therefore "okay", according to organic standards. For example, mined phosphate may contain excessive amounts of fluoride, good for teeth in very small quantities, but harmful to humans in excess. Mined phosphate also can contain small amounts of radioactive elements such as radium, which releases radon, also not good for human health. Chlorides, too, are permitted for organic cultivation but though they are naturally mined, they can be bad for both plants and soil, especially if used in excess. Some soils used by organic farmers contain such toxic elements as selenium, which can accumulate in the plant tissues and produce. Amazing, isn't it?

When refined, any impurities or toxicities such as those listed above are removed, but refined minerals make for non-organic produce. Blood meal, bone meal, fish meal and manures pose almost no potential safety hazards, but they don't dissolve very well; they must be broken down through microbial action in the soil and therefore don't work well in hydroponic applications. There is also a problem that sometimes arises when using manures.

The Western Fertilizer Handbook, an important guide for American farmers, points out that many gastro-intestinal illnesses can he traced back to manures used on organically gown crops. In the summer of 1995, a serious outbreak of salmonella poisoning resulted from an organic cantaloupe crop growing in soil fertilized with fresh chicken manure. The rinds of the melons had become contaminated and the bacteria caused serious intestinal illness for many consumers.

Another point that can be made is that strict vegetarians or animal rights activists may be offended by the use of blood, bone, horn, hoof and feather meals to grow their food, but these are primary nutrient sources for organic farmers.

As you can see, this issue Is very complex and there are many points of view. Essentially though, "organic" farming is part philosophy and part methodology, but unfortunately defined bureaucratically.

WHAT'S HYDROPONIC; WHAT'S NOT?

If a plant is grown without soil and with a complete nutrient solution, that's hydroponics! It can be as simple as plants glowing in sand, gravel or rockwool with a nutrient drip, or as complex as a complete waterculture system, such as NFT (Nutrient Film Technique) or aeroponics.

No matter what method you use, the key to successful hydroponics is nutrients. Hydroponic crops are raised on a perfected mix of primary, secondary and micro-nutrients. The formulas for different crops and environments vary, but all have been defined from extensive experience with a wide variety of crops growing in many different environments throughout the world. Problems may occur where water quality is poor and where environmental extremes of high or low temperature and humidities place stress on crops; however, when a hydroponic facility is properly planned and installed, the resulting crops can be impressive. Data generated in Europe, Israel, Canada, Australia and the United States have defined precise combinations of minerals for a variety of crops. The data is so accurate that

required elements are specified in mS (milisiemens) and uS (microsiemens), a system of measuring by electrical conductivity and calculating by atomic weight.

Based on these findings, the Dutch research station at Aalsmeer has organized nutrient solutions into three classes:

- "A" refers to formulas that have been extensively tested and can be considered reliable.
- "B" signifies formulas that are fairly new but working quite well; some changes can be expected before upgrading to a class "A."
- "C" formulas are experimental; significant changes can be anticipated before upgrading to class B or A.

Formulas are defined for a given crop growing under different conditions. For example, elements are specified for the nutrient reservoir, while a separate specification is made for the nutrients in the "root environment" if growing media is used, particularly rockwool. The root environment usually has higher concentrations of elements since minerals will accumulate in rockwool. To test the concentration within the media, the grower will squeeze some nutrient out of a sample of the media, do a basic conductivity and pH test, and sometimes send the sample to a lab for analysis. If the concentration of elements in the media rises above the recommended limits, the grower will have to adjust the formulation of the nutrient in the reservoir or run a rinse through the media to lower the nutrient concentration within the root zone.

Another formula may be defined for non-recirculating nutrient, also called "run-to-waste," where nutrient is sent from the reservoir on a one-way trip through rockwool onto the ground. This method is falling into disfavor due to the pollution caused by the nutrient run-off and discarded rockwool.

HYDROPONIC PRODUCE AND HEALTH

In 1994 a test was commissioned by an investment group to determine the vitamin and mineral content of hydroponically grown crops in comparison to soil grown crops, both organic and nonorganic. Plant Research Technologies Laboratory in San Jose,

California, analyzed tomatoes and sweet peppers; those hydroponically grown used General Hydroponics' "Flora" nutrients. The hydroponic produce showed a significant increase in vitamins and minerals beneficial to human health over the soil-grown produce. This data indicates the importance of a calibrated nutrient solution. The crops had been grown following the Dutch recommendation for hydroponic tomatoes and sweet peppers, and not only were they of higher nutritional value, the flavor was reported to be outstanding.

The hydroponic crops were further analyzed to search for chemicals on the EPA's "priority pollutant list", of which, none were found.

American agribusiness is beginning to apply hydroponics on a significant scale. Large corporate facilities are showing profits and generating high crop yields with consistent quality at facilities in Colorado, Utah and Mexico. These installations mark an important point for hydroponic farming in the United Stares. If the investments prove profitable over the long term, then steady growth is going to continue, slowly replacing many field-grown crops in the marketplace. The British have been applying hydroponic farming to meet consumer needs for decades. Farming cooperatives grow tomatoes, cucumbers and salad greens on a very large scale.

Van Heinegen Bros. produces three pounds of hydroponically grown tomatoes per year for every man, woman and child in the British lsles. In support of these enterprises, the British government runs a research facility, which investigates improved hydroponic methods, disease and pest control and new plant varieties. The cooperation between government and farmers has led to improved crop production, quality and profits.

Although hydroponically grown produce, while usually free of pesticide and other chemical hazards, does not generally meet the rather narrow definitions of "organic", it can offer superior flavor, nutrition, appearance, freshness and she1flife. Many small hydroponic growers are recognizing these market trends and cashing in on the huge demand for higher quality produce. Small

growers find that gourmet restaurants and local markets are delighted to have access to superior quality produce, whether organically or hydroponically grown.

Since "organic" is pretty much out of the question, an increasing number of hydroponic growers are promoting their produce as "pesticide-free." This gives the consumer the reassurance that their fruits and vegetables have been grown following the most important principal of "organically" grown produce.

One consequence of this dichotomy is that the term "organic agriculture" is declining in favor of the term "sustainable agriculture", which applies to both organic and hydroponic cultivation. Though many organic growers look down on hydroponic technology, the superior quality and freshness of locally grown hydroponic produce is in fact gaining market acceptance. A new niche is developing for small hydroponic growers, family farms, and even urban farms in areas that have traditionally been served by large corporate farms far away.

The simple truth is that top quality organically raised produce can only be grown under fairly ideal conditions and only seasonally in most parts of the United States. This results in produce that is expensive and frequency unavailable or shipped from afar, causing quality to suffer.

In the "organic" model, good soil is enriched with compost, blood meal, bone meal, manures and a host of other natural amendments. These components break down slowly in the soil at a rate in harmony with the plants' growth; a microbiological process is required to make the nutrients available to the plants. These microbes include many organisms that are all in a symbiotic embrace with the environment and the plants. When done skillfully in the right environment with the right crop, this is nature and farming at its finest. But it differs sharply from the hydroponic model, where microorganisms are unnecessary for the plants to absorb the prepared nutrients. The nutrient absorption rate of a hydroponically grown plant is generally much faster than that of a soil grown plant, since in hydroponics, nutrients are instantly soluble and available, as is essential oxygen.

Hydroponic plants are usually grown in a relatively sterile environment, and often with precise controls, from artificial lighting to extend growing seasons to exotic computer systems that enable the grower to actually tailor the environment to the crop wherein hydroponics becomes just one part of the entire system. In this type of setup, labor is reduced, yet plant growth rates, yields and quality increase.

Many attempts have been made to create the perfect organic-hydroponic nutrient, but so far nothing matches the purified mineral salts used in formulating hydroponic nutrient solutions. We note that the European Economic Community (EEC) has established the category of "mineral organic" for foods grown with the required mineral nutrients to supplement an organic base of nitrogen. We previously touched on the fact that United States agricultural regulations are currently set and applied at the state level but practically all states prohibit the use of refined ingredients to cultivate “organic" crops; only mined minerals can be used. Surprisingly, this precludes organic growers from using pharmaceutical or food grade ingredients to formulate fertilizers. This could be a safety risk, but at least mined minerals will break down in the soil.

Hydroponic growers, on the other hand, must use refined minerals because mined minerals dissolve poorly in solutions. As a consequence, it is not currently practical to formulate a top-quality "organic" fertilizer, which will work well for hydroponic crop production, and meet U.S. standards. The Flora nutrients developed at General Hydroponics, for example, currently meet the EEC standards for the mineral component of the "mineral-organic" category, but cannot be used in the United States to grow certified "organic" produce.

A review of the standards for defining "organic" will soon be completed by federal regulators in the U.S. Department of Agriculture. There is some possibility that the USDA way eventually consider the European standards, opening the door for organic growers to use purified mineral nutrients and hydroponic growers to cultivate organically certified produce. It is not

surprising that European regulations favor policies that promote the cultivation of produce with superior quality and flavor. Generally European consumers are accustomed to higher quality foods and will not purchase flavorless produce. The myth that only certified organically grown produce is of good quality, nutrition and flavor has been clearly dispelled by the many successes of hydroponic producers worldwide, but remains predominant in public perception. This trend will most likely continue; the only question is whether the United States will be a leader, or a follower.

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Author's note: I've tried to describe a few of the problems hydroponic growers face when trying to compete with "organic" produce. I don't wish to leave readers with the impression that there's anything wrong with organic, or that hydroponic produce is always better. It can go either way depending upon the skill and ethics of the farmer.

The main issue is for growers and consumers to understand that "organic" is a matter of definitions. Sometimes the organic produce is the best tasting and most nutritious available in the marketplace; other times the hydroponic produce is better. In the final analysis, organic farming has a low environmental impact on the Earth, and this is an important point from a philosophical view. Until hydroponic growers can find a way to recycle used water, media and nutrients, the hydroponic method will not be equal to "organic" in these terms. On the other hand, if a consumer is comparing the flavor and nutrition quality of a crop, both hydroponic and organic methods are excellent.