AHL'S
Indoor Garden Guide

WHAT'S INSIDE––

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WHY GARDEN INDOORS?

In an outdoor environment, nature gives the plant what it needs to grow: sunshine to power photosynthesis, mineral elements to convert into starches and sugars, water to carry food through the plant, and carbon dioxide for plant respiration. But some of these provisions may be more or less than the plant needs, so the resulting environment is seldom "ideal." In a controlled indoor growing environment (whether a large greenhouse or a small home grow room), you - the grower - must supply all of what the plant needs. In the beginning, this method may seem like more work than gardening outdoors, but the ability to control all of the plant's growth factors can result in much greater yields in a smaller amount of space which ultimately means LESS work for you!

INDOOR LIGHTING

Lighting is the most important factor in indoor gardening, and often the biggest financial investment. Outdoors, the sun provides more than enough light energy for plants, but growing seasons and conditions vary widely in different parts of the country. Plus, many people simply don't have the space for an outdoor garden. As long as you have adequate light, an indoor garden can provide you with fruits, vegetables and herbs year round...regardless of what is happening outside.

The main types of lighting for indoor gardens are **fluorescent** and **High Intensity Discharge (HID)**.

Fluorescent Lights

Fluorescent lights are excellent for starting seeds or rooting clones. Fixtures and bulbs are inexpensive, and the low heat output lets you put them just inches away from your delicate plants. The disadvantage of fluorescent bulbs is the low light intensity--they can grow a plant that is 8-10" tall but then the light simply can't penetrate any further. If the plant grows taller and you keep raising the bulb, lower sections of the plant will not receive adequate light. Using a "full spectrum" fluorescent bulb

will give your plants all the necessary wavelengths of light.

High Intensity Discharge (HID) Lights

High Intensity Discharge, or HID, light bulbs have revolutionized the indoor gardening industry in the last 25 years. These bulbs require special ballasts (transformers) and sockets to operate, which are included with light systems. HID light systems are designed to operate on normal household (110v/120v) current, but most can be converted to 220/240 volt operation if desired. These lights are designed for use in home garden rooms and greenhouses, and are completely safe if used with common sense and according to the instructions.

Many types of light bulbs fall into the HID category, but the two best choices for plant growth and maintenance are **Metal Halide** and **High Pressure Sodium**.

Metal Halide (MH/MS)

Metal Halide lamps are the best single source of artificial light for indoor gardening. Their balanced light spectrum, similar to the tropical sun, contains the important blue and red wavelengths that plants need for rapid vegetative growth. You can grow your plants from start to finish under a metal halide lighting system. MH lamps come in 175, 250, 400, and 1000 watt sizes. NOTE: Horizontal Metal Halide light systems require the use of a tempered glass safety lens in order to be UL listed for safety.

High Pressure Sodium (HPS)

High Pressure Sodium lamps emit light which is heavily concentrated in the red and orange region of the spectrum. This heavy red light promotes excellent fruit or flower production (as much as 30% more than a metal halide lamp), but the lack of blue spectrum light can sometimes make a plant stretch or become "leggy" during the vegetative growth stage. This type of light is ideal for supplementing sunlight in a greenhouse or sunroom. A High Pressure Sodium system is the most efficient HID light because it has the highest number of lumens per watt (roughly 10-15% more than a metal halide bulb of the same wattage.) HPS lamps come in 150, 250, 400, 600, and 1000 watt sizes. The ideal lighting system would include both a Metal Halide and a High Pressure Sodium lamp. This would produce extremely fast growth as well as increase flowering by 40 percent. To avoid the expense of purchasing two separate lighting systems, you can use a **conversion bulb** or an **enhanced spectrum bulb**.

Conversion Bulbs

High Pressure Sodium Conversion bulbs are specially designed to run off a Metal Halide ballast but they put out more lumens, more red spectrum light, and they run off less electricity. Start your crop under the MH bulb and then switch to the HPS conversion bulb when flowering begins. Bulbs that convert MH into HPS are available for 175, 250, 400, and 1000 watt systems. **Metal Halide Conversion bulbs** allow you to take the opposite approach: grow your plants under the conversion bulb during the vegetative stage, then switch to your regular high pressure sodium bulb for flowering. HPS to MH conversions are only offered in the 250, 400, and 1000 watt sizes.

If you are planning to purchase a system with a conversion bulb, consider which light spectrum you will use most. If you will need mostly the vegetative light spectrum with short periods of flowering light, buy the metal halide system with a high pressure sodium conversion bulb. If you will have a relatively short vegetative phase followed by a longer flowering phase, buy the high pressure sodium system with the metal halide conversion bulb. Either approach will work, but purchasing the system of the type you will use most will give you much more efficiency in the long run.

Enhanced Spectrum Bulbs

If you only want to deal with one bulb through all stages of growth, another option is to use an enhanced spectrum or "corrected" bulb. **High Pressure Sodium Son Agro** bulbs are engineered to provide 30% more blue spectrum light than a standard HPS bulb. These are available in 160, 270, or 430 watts. **Agrosun Metal Halide** bulbs are engineered to provide more red spectrum light (38%—49%) than a standard halide bulb. Agrosun bulbs are available for 250, 400, and 1000 watt systems.

Bulb Replacement

Replace metal halide bulbs after 1 to 1 1/2 years of use, and replace high pressure sodium bulbs after 1 1/2 to 2 years of use. The bulbs will continue to light beyond this point but have lost as much as 30% of their lumen output while still consuming the same amount of electricity. When replacing your bulb, it is critical to get the right one for your ballast and reflector configuration. Contact AHL if you have any questions!

Light Movers

You can use an automatic light mover to increase the coverage area and efficiency of your light without using any more electricity. Since the light is always in motion and does not rest above any part of the gar-

growing season.

HYDROPONIC GROWTH MEDIA

By definition, a hydroponic medium should offer no nutritive value-its sole purpose is to provide support for the plant and to allow an even distribution of the nutrient solution. An ideal growing medium is sterile, inert, water- and nutrient-retentive, free-draining, non-toxic, and will promote vigorous root development.

Rockwool

Rockwool is the most revolutionary soilless medium to date. Horticultural Rockwool is made of volcanic basaltic rock and a binder which prevents potassium hydroxide and other elements from leaching into the nutrient solution. Rockwool provides 90-95 percent air space between its fibers. It is capable of holding more nutrient solution and more air than any other medium. When the Rockwool is completely saturated, it maintains a ratio of air to water which is ideal for promoting root development: 80 percent nutrient solution, 15 percent air space, and 5 percent Rockwool fibers.

Fired Clay Grow Rocks

Fired Clay Pellets, often called grow rocks, are manufactured by heating clay pellets to very high temperatures, causing them to expand and puff up with air. Grow rocks retain moisture because they are porous, while the irregular shape and rough surface of the rocks promotes free drainage and air circulation. Grow rocks can also be reused from one crop to the next.

Coconut Fiber

Coconut Fiber is an exciting new hydroponic medium that also works great as a soil amendment. The fibers, which are also called coconut coir, are made from the inner husk of coconuts. This renewable resource offers excellent water holding capacity along with free drainage. Coconut fiber is rich in natural rooting hormones and other organic compounds.

Perlite

Perlite, or puffed sand, is a sterile and lightweight medium. It is a good medium for lettuce, cabbage, herbs, and other small crops. Its major drawback is its inability to give good support to the plants. It also tends to promote algae growth more than other media. Perlite is an excellent medium when used in grow bags or when combined with clay pellets in a reservoir or wick system. Perlite should be discarded after only one use.

PLANT FOODS & NUTRITION

All plants need nutrients. Outdoors, plants take certain elements from the earth and combine them with water and air. Using energy from sunlight they create simple sugars, carbohydrates, and proteins to feed both themselves and all living things on this planet. A hydroponic solution must supply all the necessary nutrients in the proper form and ratio for plant growth. All major, minor, and trace elements must be properly balanced and water soluble. The three major plant elements are nitrogen, phosphorus, and potassium—often abbreviated as N-P-K. The three numbers on every fertilizer label refer to the percentages of these three essential elements. The minor elements include calcium, magnesium, sulfur, and iron. The trace elements necessary for good plant development are manganese, boron, copper, zinc, chlorine, molybdenum, and cobalt. Plants need very small amounts of the trace elements, but they are important because they act as catalysts in the solution. Without the right amounts, a plant can't properly utilize the major elements, and may develop deficiencies, disease, reduced growth rates, and poor yield.

Synthetic Nutrients

It is important to use a nutrient that is designed specifically for hydroponic applications. While products like Peter's and Miracle Grow are adequate for soil plants, they will not perform well in hydroponic systems because they lack the proper ratios of trace elements. If you are using a dry or solid nutrient concentrate, make sure it's derived from soluble and chelated minerals. Most hydroponic gardeners use a synthetic (or chemical) liquid nutrient formula, and many excellent brands are available. These liquid nutrients contain all major, minor, and trace elements in exact proportions, and they are usually formulated to keep pH stabile and reduce fertilizer salt build-up. Synthetic nutrients will provide the fast, lush growth that most people associate with hydroponics!

Organic Nutrients

Think of organic nutrients as a raw food source for plants. While a synthetic, or chemically derived, nutrient will contain mineral elements (such as nitrogen, calcium, etc.) that are immediately available to the plant, an organic nutrient (such as bat guano or bone meal) must break down in order to release these mineral foods to the plant. Organic nutrients are excellent for use in soil because beneficial bacteria will speed up this process. In hydroponics, organic nutrients become trickier because these living "catalysts" are not usually present. However, many organic nutrients can be used successfully in hydroponic systems, and some gardeners find that the slower growth rates are worth it for better looking, better tasting produce. Depending on the type of hydro system

you use, you will have to decide on the best type of organic nutrient. Consider if clogging will occur (drip emitters, lines, pumps, etc.), and also the different smells associated with organic fertilizers. An organic/synthetic combination will promote the aggressive growth associated with synthetics and the high quality and heavy yield standards of organically grown produce. Using organic nutrients or supplements will improve the overall health, taste, and texture of all types of plants.

Nutrient Cycles

A plant's nutritional requirements change depending upon its stage of growth. Generally, during the vegetative cycle a plant requires high amounts of nitrogen with lesser amounts of potassium and phosphorus. During this stage you should use a Grow formula nutrient. When the plant moves into the blooming or flowering stage, the plant needs more phosphorus and much less nitrogen. During this stage, use a Bloom formula nutrient instead of the Grow formula in order to slow vegetative growth and promote flowering and fruiting. You should also adjust nutrient strength depending on the age of your plants. Feed seedlings and cuttings with a mild strength nutrient solution for the first 2-4 weeks, then increase to a "normal" strength nutrient mixture. After the first month of growth is completed, you can determine the nutrient solution strength according to the needs of your plants. It s best to follow directions on the label, or contact AHL with any questions. It is very easy to over fertilize, and difficult for plants to recover from fertilizer burn. Remember, when it comes to nutrients, less is more!

pH

The pH reading is a measure of a solution's acidity or alkalinity. It is measured on a scale from 1 to 14: an acidic solution has a pH less than 7.0, while an alkaline solution has a pH greater than 7.0. The pH of a nutrient solution or soil is directly related to the plants' ability to absorb the necessary nutrients. Most plants perform best in a hydroponic solution maintained at an average pH of 6.3. Your pH will fluctuate constantly, so check and adjust it daily if possible. You can adjust pH by adding either pH up (base) or pH down (acid) to the water. Household chemicals, such as vinegar, are not recommended because they cannot maintain a stable pH after adjustment. To adjust pH of water already circulating in your system, add the acid (pH down) or base (pH up) to your system, then check pH again in about one hour—after the adjustor has fully mixed and stabilized. For a soil garden, it is not as critical to check and maintain an exact pH because soil is a better buffer for nutrients than a hydroponic solution. However, many soil gardeners will check pH periodically just to make sure everything is OK, and soil gardeners should check pH if the plant shows signs of nutrient deficiency that might be

related to pH imbalance.

Total Dissolved Solids (TDS)

A dissolved solids reading, measured in terms of parts per million (PPM), tells you how many parts of a dissolved solid are suspended in a solution. (A reading of 1500 ppm means there are 1500 solid parts dissolved in 1,000,000 parts of solution.) You should maintain your nutrient solution between 600 and 1200 ppm, although ideal levels change from plant to plant, and even from one growth stage to the next. If your dissolved solids reading is too high, add plain water to the solution to dilute the salts. If your TDS reading is too low, add nutrients to increase the concentration in your solution. A TDS reading is a helpful way to judge overall nutrient strength, but it cannot distinguish between different elements, or between dissolved solids that were present in the solution before you added the nutrient. Dissolved solids can only be measured using an electronic TDS meter.

Electrical Conductivity (EC)

Electrical Conductivity (EC) is another way to measure the relative strength of a nutrient solution. (In fact, a TDS meter is actually measuring the electrical conductivity of a solution but converting that data internally before displaying a reading in PPM). As with TDS, the only way to measure EC is using an electronic EC meter. One advantage of using an EC meter is that EC is the standard of measurement in every part of the world other than North America. Another, and more important advantage, is that EC readings are more consistent than TDS readings because different companies use different conversion factors to achieve the TDS reading. Therefore TDS meters from different companies will not necessarily give the same readings in the same solution.

Water Temperature

You should maintain a constant temperature between 70¡ and 80¡F in your nutrient reservoir. This is important, especially during the cool months, to help increase plant performance. Do not increase the temperature above 85¡F as this may cause root damage. You can use an aquarium heater to maintain the temperature in your reservoir. It takes at least 5 watts per gallon to heat and maintain a constant nutrient temperature (for example, a 10 gallon reservoir requires a 50 watt heater). You can also place the reservoir on a piece of Styrofoam or wood to provide some insulation if you are growing on a concrete or tiled floor.

ENVIRONMENT

Air Temperature & Humidity

Most plants grow well with room temperatures between 50¡ and 90¡F, with a median temperature of about 75¡F. Your specific plant's needs will vary: think about where your species of plant originates and try to recreate a similar environment. Plants also need a certain amount of water vapor, or humidity, in the air to help control transpiration (breathing) and prevent wilting. On average, a relative humidity between 25 and 75 percent is good, with the median range around 50 percent. If your room is too hot or too humid for you, it is probably too hot and humid for your plants. Excess heat and humidity should be vented away from the growing area with exhaust fans. Alternatively, you can add a heater if the air is too cold, or a humidifier if the air is too dry. Environmental control equipment can be used to turn on fans when temperature or humidity rises, then turn them off when levels have dropped. You should also use a small circulation fan in your garden area. This fan can run all the time to provide air movement around the plants, strengthening plant stems and providing fresh air to the stomata (the cells on the undersides of leaves where the plant "breathes").

Carbon Dioxide (CO2)

Carbon dioxide (CO2) is probably one of the most overlooked requirements for good plant growth. Plant respiration is opposite of human respiration- they breathe in carbon dioxide and breathe out oxygen. Normal air contains 300-400 ppm of CO2, but growing plants quickly use this amount when confined to a small space. Test kits are available to determine how much CO2 is in your air. If you exchange your air regularly—by using a vent fan to bring in fresh air and another fan to exhaust stale air—you can usually give your indoor plants a CO2 level similar to what they would have outdoors. However, if you add much greater amounts of CO2 to the air you can speed up photosynthesis, resulting in faster growth and greater yields. For every increase in CO2 up to 1500 ppm, there is an increase in growth rate. This is called the "point of diminishing return," after which point each increase causes a corresponding decrease in growth rate. You can add CO2 to your grow room by installing a CO2 tank with a regulator and a solenoid valve, then attach this unit to a timer to disperse measured amounts of CO2 at regular intervals. Always place distribution tubing above your plants because CO2 is heavier than air and "falls" as soon as it leaves the tubing. Another option is to run the CO2 tubing into the back of a small oscillating fan which will blow CO2 through the plant canopy. You can also introduce CO2 using special generators which run off natural gas or propane. These generators produce quite a bit of heat, and they

must be located directly inside the garden area, so keep this in mind when planning the garden environment.

STARTING PLANTS

Starting Seeds

"Plant propagation" simply means starting plants from seed or clones. Most indoor gardeners prefer to start their own seeds rather than buy seedlings from a nursery. They are usually able to get stronger, healthier plants because they can optimize conditions from the very beginning, plus eliminate the possibility of bringing in an insect or disease. Plus, you can buy exotic seed varieties from all over the country, or even other parts of the world. Gardening is a lot more fun when you aren't limited to the two kinds of boring tomato plants on sale at your local nursery! Hydroponic gardeners benefit the most from starting their own seeds because they can sow them in a soilless medium such as rockwool, which makes the transition to a hydroponic system much easier.

Cloning

The word "cloning" may sound complex and scientific, but the idea is as simple as taking a cutting from a houseplant and rooting it in order to produce another plant. The advantages of cloning are numerous: you can select your best specimen to be the mother plant, meaning that your clones will have the same good genes and growth characteristics; you can speed up your time to harvest because clones are ready for transplanting much faster than plants grown from seed; and clones tend to be more uniform in size and height than seedlings--a big advantage if you are gardening with artificial light.

INSECTS & PESTS

Indoor gardens tend to have fewer insect problems than outdoor gardens, especially if hydroponic systems are used. Many insects spend part of their life cycle in soil, so eliminating that also eliminates those insects. In addition, hydroponically grown plants tend to be stronger and healthier than soil-grown plants, which makes them more resistant to insects. But of course problems do occur sometimes, especially since tiny pests can enter your garden room from other parts of your home, through vent fans, or even on your clothes or shoes! Pests are usually controlled more easily inside than outside because the space is confined, but they may also multiply rapidly without the natural predators that keep their numbers under control outdoors. If you find insects in

your indoor garden, there are many ways to eradicate them or at least keep them under control. Most home gardeners prefer milder pesticides, such as those made from the pyrethrum plant, or "insecticidal soap" sprays which kill insects on contact but leave no residue on plants. Plant oil extracts, including neem oil, offer a totally organic method. And more and more growers are using natural predators and parasites. These "beneficial insects" are raised in specialized insectaries and are the most "natural" form of pest control available.

PLANT DISEASES

Plant diseases can be placed into one of three categories: fungus, bacterium, or virus. Most plant diseases are caused by fungi. Many plant diseases are caused or encouraged by poor drainage, poor or unbalanced soil/pH/nutrients, inadequate air circulation, insect damage, or unsanitary conditions. When plants show unhealthy signs, analyze the symptoms. Before assuming it is a disease, first look carefully on the undersides of leaves for a pest problem. Typical symptoms of disease include spots of various sizes and colors, abnormal localized swelling (galls), blights (sudden death of foliage, branches, or flowers), rots (general decomposition of plant tissue), cankers (dead areas on bark or stems which are often discolored and may be raised or sunken), and general dwindling of plant health. There are a few things you can do to help prevent plant diseases. Whenever possible, work in your garden area when foliage is dry. Most bacteria and fungus need moisture to travel from plant to plant. Make sure to wash your hands after removing any diseased plant from the garden. You can also plant disease-resistant plant varieties. Make sure to allow enough space between plants for the air to circulate freely. Fungus can be prevented by controlling temperature and humidity. A fungus can spread like wildfire! Use a fungicide spray if the fungus gets a good start and appears to be spreading. Apply the fungicide at least twice, about 5-10 days apart.