Winter Greens on a Greenhouse Energy Budget

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The consumption of energy is a major component of running a greenhouse, especially in the winter when energy bills are at an all time high. Whether you have a greenhouse or are looking at acquiring one, reducing the need for energy during the winter without turning the greenhouse off, is a major concern. We will explore this topic in this article. As well, we will discuss the kind of crops that can be grown in the greenhouse when energy consumption is reduced.

**Vegetative versus Reproductive Crops**

Vegetative crops like lettuce and oriental vegetables require less light than fruiting crops like tomatoes or cucumbers. Fruiting crops require less light when the plants are younger and still in the vegetative growth stage. As fruit sets on these plants, the light requirement increases. If the increased light requirement is not met, the fruit setting and sizing processes in the plants will stop or at least decrease.

Therefore, growing vegetative crops will allow you to grow more plant material without supplementing light. This keeps the energy input down but it does restrict the range of crops that can successfully grow in the greenhouse during the lower light growing period.

When we eat most of the vegetative tissue of the greenhouse grown plant, we are making the best use of the plant material we produce in the lower energy input environment. This may require an adjustment to our diet or to the expectations of what we will grow in the greenhouse during the heating season.

**Cool Weather Crops**

Some plants fare better with frequent to regular temperature drops than other plants. We need to consider edible plants that will not only survive frequent lower temperature periods but also grow and produce fresh plant matter during such time periods.

When environmental temperatures are low, around 40°F, plants will not be actively growing. They will be surviving. We need to be growing plants that will grow when the temperature rises into the growing range for the plant. That is the key. A rapid growth response is needed to increase in temperature. It takes many types of plants a couple days or more after a cold exposure before they will resume to normal growth rate. Therefore, we will be looking at plants that can recover from an overnight cool period and grow during favorable conditions that occur during the following warmer daylight period.

The growth rate of these plants will be slower than it would be if the lowest temperature were maintained at 55°F or 60°F. The slower growth rate and a lower energy input may be what you may want for producing your own fresh food during the winter. More growing space and an
increased number of slower growing plants will need to be grown to meet your appetite needs when these procedures are used.

**Lettuces and Oriental Vegetables**

Lettuces and many oriental vegetables will still grow under the conditions described above. The growth rate will be slower than if higher minimum temperatures were maintained and more light were available, but enough slower growth is attainable to keep you eating all winter.

Bibb, romaine and regular green leaf lettuces should do relatively well in this growing environment. Try several cultivars because some may fare better than others for you. Even if a cultivar does not do well for you the first time you try it, try it again at a later time. Keep notes on the results and the time frame. They will be useful to you in the future. Different day lengths and cloudy schedules will affect different lettuce cultivars differently. Always grow a selection of different cultivars because you will then have a better chance of good performance from at least some of your plants. It will give you more variety in your salad.

Red leaf lettuces are not likely to do well at red color pigment development in this type of environment. Growers who want to grow red leaf lettuce in the winter will supplement with carbon dioxide or increase the light intensity to enhance the red color development. Both these processes are energy demanding processes. Therefore, you may want to save the growing of red leaf lettuces to the warmer, higher light times of the year.

Many of the green leafy oriental vegetables are in the cabbage family. Most members of this family will grow when night temperatures get low as long as the day temperatures are warmer. Many of them will grow as fast or faster than lettuce. If you are not familiar with them, you may not know how to go about eating them once you have them growing. You may want to check out some recipes for some of the new things you try before too many of them get ready to be used.

Oriental vegetables are usually cut up into bite-sized pieces and stir fried by the cooks in many oriental cultures. This is a low energy input preparation also. No excess cooking water is heated. The vegetables are often cooked only until they begin to soften. This preparation process also requires less heat energy than many that we use. Although oriental vegetables are characteristically at least slightly cooked, many of them are tasty salad ingredients. The fertilizer program in the hydroponic system allows for that while the traditional cultivation of these plants necessitates their being cooked for human consumption.

More familiar members of the cabbage family can also be grown in the greenhouse conditions we are discussing. Things like kale, mustard greens and even collards can be grown. The collards would need to be picked and used while young or provisions would need to be made in the greenhouse for much bigger plants.

**Adjustments to the Production System and Procedures**

There is more to the successful production of these vegetative plants at lower night temperatures than just turning down the thermostat. In most places, the heating system will still be needed to
maintain minimum temperatures. If temperatures get below freezing, lettuces do not survive. Cabbage family members may take a degree or two of frost for a few hours without damage. A hard freeze will stop up the distribution system and maybe break pipes if the temperature gets low enough.

**NFT System Modifications**

Running the nutrient solution through the channels all night is not necessary when greenhouse temperatures are going to be lower. Doing so would cool the nutrient solution down to the temperature of the greenhouse. Turning the flow of the nutrient solution off in the evening and on in the morning will require the use of a timer. It will allow the temperature of the nutrient solution to be kept higher in an insulated reservoir than it would have been if it had been circulated all night. This is an energy saving feature.

The circulation of the nutrient solution will need to be turned off an hour or so before dark. This will be after the temperature in the greenhouse has started to fall but not long enough after for the solution temperature to have dropped too much. Transpiration from the plants will slow as the temperature drops and the solution stops flowing over the roots. The relative humidity in the greenhouse, however, will probably rise.

As morning approaches, some energy input will need to be made because of the presence of condensed water on the plants. When the relative humidity approaches 100 per cent, water will condense out on the surface of the cooler plant tissue. This may not occur every night or early morning, but even in drier environment areas it will occur sometimes. The relative humidity will need to be watched and tracked closely when the temperature is allowed to go down into the 40°’s and high 30°’s at night.

The use of fans to move the air and help evaporate the water off the plant tissue will be necessary. In some environmental locations and at some times, the use of fans will not be enough. Heat may need to be put into the environment before the heat of the day starts to accumulate in the greenhouse. If nothing is done before the greenhouse heats up from the sun, the temperature and relative humidity changes can be so fast that tissue plant tissue damage is caused.

**Tempered Water Reservoir**

When water is added to the re-circulating nutrient reservoir, it should be added from a tank in the greenhouse that has held the water for a day or more so that the temperature of the water has come up to the greenhouse temperature. This will eliminate a drop in the nutrient solution temperature when water is added to make up for what has been used by the plants. Water coming into the greenhouse in the winter time will be colder than we want going to the roots of the plants.

The reserve water tank should have a capacity of about twice the amount of water that would be added to the nutrient system in a day. That provides a little backup for heavy use days but allows the water to warm up to greenhouse temperature during the daylight period when there is solar heat input to the greenhouse. It can be mounted high enough in the greenhouse to allow the water to flow by gravity from it into the reservoir.
A second reserve tank should be used to temper the water that is used to fill the reservoir when the nutrient solution is completely replaced. This can be done every two weeks in a small system where there is adequate reservoir volume per plant. Because this is a bigger tank, it may be more practical to place it on the floor. Although this would then require the use of a pump to pump the water into the reservoir, the pump would only be used every couple weeks to do this job.

**Adjusted Plant Targets and Tolerances**

Less than market maturity should be your harvest target for your crops. Lettuce plants become less tolerant to some of the extremes they may experience in the type of environment we are describing as they get further developed and closer to market maturity. In addition to some of the things suggested above, we can harvest the plants at a younger age. This will improve their taste and tenderness. It will shorten their shelf life. You do not, however, need to keep the plant material in the refrigerator for days if you have more in your greenhouse.

As the young plant leaves expand, their cells take in water and enlarge before they fortify themselves with a cell wall. The cells at the edge of the leaves are the last to receive water if there is a sudden shortage or they get more than they need if the plant finds itself over supplied with water. The tender cells can collapse or burst. Either way they die. They, of course, do not continue to grow like the surviving cells to which they are attached. The expansion of those surviving cells, however, is distorted and often restricted because of their connection to the cells that collapsed or burst. The growth of the young leaves is restricted, wrinkled and puckered like illustrated in the lettuce in the accompanying picture.

Although the appearance of this lettuce is different and unacceptable in the market, the lettuce is still good to eat. It should be harvested shortly after this type of damage has occurred. The plant will not grow properly once this kind of damage is present.

This type of damage is more likely to occur when the leaves in the middle of the head start to close in over the young expanding leaves. This is why it is better to pick and use the lettuce before the middle of the head is filled in like it would be for the market.

Cabbage family members are also subject to the same type of damage. It will usually not occur as easily in these plants. It will take more severe conditions to cause the cell damage in these plants. Damage will be seen in the lettuces before it is seen in the oriental vegetables or other members of the cabbage family.

Leaf cell tissue damage can also occur in the morning when water has condensed on the plant tissue as mentioned above. The evaporation of the water from the tissue, due to the warming of the environment by the sun, will cool the young expanding cells at the edge of the growing leaves. The increased flow of the water to the cells because of the startup of the plant activity for the day will burst the young cells because more water is pushed into them than they can accommodate because of being cooled by the evaporating water.
Conclusion

Before high energy costs in winter cause you to shut down your greenhouse, consider modifications in energy input and the way you grow the plants. A reduced energy input with a reduced plant output may fit within your budget and give you some fresh edibles this winter. The cost of the items you could grow in the greenhouse will probably continue to go up in the grocery store. The quality of the shipped product will not compare with the quality of what you can grow in your greenhouse. Enjoy growing and eating your own plants even on an energy budget.