

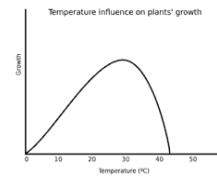
Feature Article: [December, 2009](#)

Temperature and Humidity: Winning Factors in the Garden

by Isabelle Lemay, agr. and Melissa Leveille | 2009-12-01

There is on earth, amazing vegetal diversity! Species abound per millions and vary from one region to another in line with the climatic conditions, the soil quality, the luminosity and many other factors. For one moment, imagine yourself in the African Savannah - the blazing sun heats the atmosphere and the air is particularly dry. Around you long yellowish mature, grass-like wheat is growing. Here and there appear some stunted trees and bushes. Now, transport yourself to the north, in England - the clouds are rushing through the sky leaving only a few sun rays breaking through. The cold temperature, combined with the humidity, gets to the bones and gives you the shivers! But what magnificent nature! The hills radiate from an intense green; so green it seems to glow. These descriptions offer a gripping contrast, helping us understand that vegetal species from these respective regions are well adapted to their environment and would probably not survive in the opposite climate; each requires unique growing conditions.

Following this logic - it is essential to know the cultivated plants' particular needs well to obtain good results. The aspects to consider are numerous but the climate, particularly temperature and humidity, certainly influence the growth and the yield (harvest quantity and quality) the most. So, what are the effects of climate on plants and which methods can be used to more efficiently control them in indoor gardening?



Temperature influence on plants' growth.

Temperature's role and its impacts

Many aspects of plant functions and development are influenced by temperature. We can't enumerate all of them because of their large number and their complexity but we will tackle the main ones. First, temperature influences certain processes, which directly affect the plant's growth such as photosynthesis and cellular respiration (Lemay and Léveillé 2009:90). The temperature also affects the plant's physical development by improving or limiting the tissues' growth and the cells' division. Some phenomena are also triggered at a certain temperature level like dormancy, blooming and seed germination. To simplify, remember that the temperature directly influences the harvest's quality as well as the yield. There lies the importance of ensuring a good control of this factor in the garden in order to meet the cultivated plants' needs.

For each species, there is an interval of optimal temperature within which the growth is at its maximum. To complicate things a little, this interval can change in time, even for a same plant. Why? Many factors are involved; some belong specifically to plants, like the age or the development stage (growth, flowering), and others are external to the plants, like the growing conditions (luminosity, CO2 concentration). For example, the optimal temperature diminishes with the plant's age but raises with high luminosity or high CO2 concentration. Depending on the plant's state, it is a question of finding a balance between the luminous intensity, the CO2 concentration and the temperature.

Humidity's role and its impacts

Many measurement units are used to calculate the humidity in the air but "relative humidity" is practical and commonly referred to. Expressed as a percentage, relative humidity is the amount of moisture in the air compared to what the air can "hold" at that temperature. When the air can't hold more moisture, then it condenses as dew. It is important to know that the air temperature influences the maximal quantity of water vapor that it can contain; at equal volume, warm air could contain more water vapor than cold air.

Humidity's most significant impact on vegetal species is its considerable influence on plant's transpiration, one of the most important mechanisms. In fact, transpiration, meaning a loss of water vapor from the stomas, creates the necessary suction to transport the water in the plant and draw water and nutrients through the roots. A high humidity level reduces the transpiration process as well as the absorption and circulation of water and nutrients. So it results into a diminution of the photosynthesis process and the growth, even if all the other conditions are perfect.

Favorable conditions for light and darkness

Plant	T ¹ -day (°F)	T ¹ -night (°F)	RH ² -day (%)	RH ² -night (%)
Tomato	70-77	59-64	60-80	70
Cucumber	71-82	65-71	65-85	65-85
Lettuce	57-64	50-55	60-85	60-85
Pepper	71-73	62-69	75-80	85-95
Berries	64-73	60-67	50-80	40-60

¹The ideal temperature range may vary depending on species, CO₂ and the plant's age.
²Ideal temperature and relative humidity level for day and night.

In nature, plants are submitted to a variable climate between day and night.

Generally, they also need different temperature and humidity levels for light and dark periods. For their good development, the majority of vegetal species prefer a temperature that is a few degrees lower at night than during the day. Depending on the scale of the variation, the effects on the crop might be different. Let's take for example a tomato plant: a large difference of temperature between the light period and the dark period improves fruit production whereas a small variation promotes the leaves and stems' growth.

Avoiding extreme temperature and humidity variations

As mentioned earlier, each plant has a range of humidity levels and temperatures where they're comfortable. So it is important to maintain the garden's conditions as close as possible to those values. Harsh humidity and temperature variations are to be avoided, since they severely stress the plants, which might result in significant consequences, such as a major slowing down of photosynthesis and growth, some lesions on leaves or fruits or even the plant's protein degradation.

It is also important to avoid extreme climates as they are extremely harmful to plants. In the case of very cold or very hot temperatures, the crop's yield and growth may diminish or stop completely. It could even cause the plant's death. As for humidity, a too high level limits the transpiration and can provoke a deficiency towards mineral elements, especially calcium. The lack of calcium may lead to other disorders such as "tip burn" on the leaves or "blossom-end rot" on the fruits. In addition, a high humidity level generally tends to develop bacteria, fungus or molds that reduce the harvest quantity and quality.

Intake/exhaust fan	Stabilizes the garden's temperature and humidity levels by either increasing or decreasing them, depending on the outdoor air conditions.
Air conditioner	Cools and de-humidifies air.
Heating system	Heats and de-humidifies air.
Mist system or evaporative cooler	<ul style="list-style-type: none"> Each gram of evaporated water extracts 540 heat units from the air. Based on this principle, they allow air cooling from the water evaporation. Humidifies the air.
Humidifier	Humidifies the air from the garden.
Mist system or evaporative cooler	<ul style="list-style-type: none"> Balances the garden conditions. The misting discourages an establishment, for example, combating against a difference of temperature between the bottom and the top of the plants.

Inappropriate humidity level is harmful for the harvest

A low humidity level brings some different problems, particularly transpiration, which might lead to wilting and plant's death. To protect itself, the plant closes the stomas and the photosynthesis process is stopped. Also, abundant transpiration sends a lot of water towards the leaves and cuts off the calcium contribution towards the fruits.

With all the disorders caused by a poor humidity and temperature management, we better understand the importance of managing these parameters in the garden properly. Which way is efficient?

Choosing equipment for temperature and humidity control

Certain equipment can be used to maintain the temperature and humidity levels in the most profitable range for the plant. It is necessary to identify which equipment is well adapted to the garden and plants. As most equipment influences at once the temperature and humidity conditions, it is beneficial to combine their actions to obtain a climate that is as stable as possible. Here are some examples of equipment and their impacts on the garden:

Besides judiciously selecting the equipments, it is still necessary to install them at the right location. The equipment should never be placed too close to the plants for prevention against extreme conditions and harsh climate variations. At all times, avoid directing warm or cold air on the plants in order to eliminate a considerable stress.

Taking advantage of controllers to combine precision and simplicity

Thermometer and hygrometers are both reference tools essential for temperature and humidity control. Some gardeners choose to manually control these parameters, but they quickly realize that this method requires a lot of manipulations and, at the end, is not precise!

A controller's functioning is simple: with built-in sensors to measure the ambient temperature and relative humidity, they activate the appropriate equipment when the climate conditions are different than the ones programmed in the controller. Not only does it simplify the gardener's work, the controller is also a beneficial investment allowing better harvest with high quality and maximum yields. To respond precisely to the plants' needs, some controllers even offer a different setting for the light and dark periods (day/night). The models that include a light sensor considerably simplify the controller's programming: the light activates the day set points while the absence of light activates the night set points. This way, the grower is able to avoid programming errors related to timing devices.

It can also be really effective to use a combined controller, meaning that it simultaneously controls more than one climate parameter and can intelligently manage many pieces of equipment. In addition to improving climate stability, this type of controller allows for better exploitation of the combined equipments' benefits. Most importantly, the controller simultaneously manages climate parameters that influence each other, like temperature and humidity, and also CO2 concentration (carbon dioxide), which has a major impact on the harvests' yield.