BioChambers
PROVIDING GROWTH TO RESEARCH.

FREQUENTLY ASKED QUESTIONS
with Dr. Patrick Friesen

## FAQ QUESTION #2

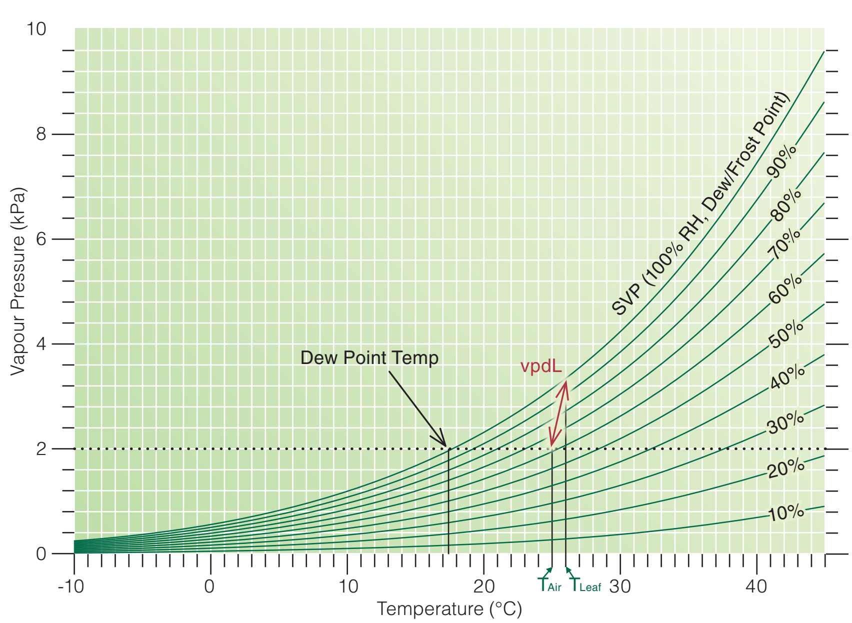
# How do I know if I need humidity control?

Whether or not you need humidity control depends on which plants you are growing, where you and your equipment are located, and ultimately your plant growth goals. Even with adequate soil moisture, plants may close the pores on their leaves (stomata) under low humidity conditions to limit water loss. Stomatal closure can reduce the rate of photosynthesis ($CO_2$ assimilation) and growth under low humidity conditions (Cowan 1978, Farquhar & Sharkey 1982, Meinzer 2003, Rawson et al 1977). Under high humidity conditions, the greatest concern for plant health may be infection from microbial pathogens for well-fertilized plants (Carisse & Kushalappa 1992, Carroll & Wilcox 2003, Diab et al 1982, Li et al 2014). Increasing the humidity can stimulate the growth of some plants while for others a wide range of humidities has little or no growth effects (Codarin et al 2006, Hunter et al 1985, Mortensen 1986, Mortensen & Gislerød 1990, Mortley et al 1994). The vapor pressure deficit based on leaf temperature is the best parameter to use and measure humidity effects on plant growth and is independent of the temperature related ambiguity of relative humidity (Friesen 2020, Lambers & Oliveira 2019, Nobel 1991, Spomer & Tibbitts 1997, Figure 1). Transferring plants grown under high humidity to low humidity (eg. when moving plants) can cause “humidity shock”, which is the result of rapid water loss, potentially causing wilting (Carvalho et al 2016, Thioune et al 2017). To prevent or mitigate humidity shock, lightly cover the above-ground plant body with plastic to create a more humid micro-climate when moving plants. Leave the plastic on for some time (hour(s)) until plants have acclimated their stomata to the new environment.

The humidity inside a growth chamber or room depends on the humidity of the fresh air flowing into it, which in turn depends on where in the world your chamber is located, the time of year, and the conditions inside the building where your growth chamber is installed. The plant species you work with, your geographic location, the time of year, and your building HVAC system may all influence whether you require additive humidity or de-humidification options (Friesen 2020).

FIGURE 1

Saturation Vapor Pressure (SVP) curve with constant Relative Humidity (RH, %) lines over a range of temperatures. Here we illustrate how to estimate and interpret the vapor pressure deficit based on leaf temperature (vpdL). In this example, the growth chamber air temperature is 25°C and the leaf temperature is 26°C. The air has a vapor pressure (VP) of 2kPa, which means at 25°C it is at 62% RH, and becomes saturated (100% RH ), at 17.5°C, its dew point temperature (DPT). The vpdL is 3.3kPa ($SVP_{\text{leaf temp}}$) – 2kPa ($VP_{\text{air}}$) = 1.3kPa. This SVP curve is available as a table, allowing you to easily calculate the vpdL when RH, leaf temperature, and air temperature are known (www.biochambers.com/knowledge/SVPTable.pdf).



## Questions to ask yourself:

- Which plants will I be growing with this equipment?
- What are my plant growth goals?
- Am I located in a dry or seasonally dry location, or am I located in a humid or seasonably humid location?
- If humidity affects the growth rate of the plants I work with, how important is maintaining comparable growth rates to other studies?
- Would it be cost effective to add humidity to stimulate plant growth for production purposes?
- Are microbial pathogens a concern and do I need de-humidification to help prevent infection?

Plants, wet soil, and overwatering all add water vapor to the air and increase the humidity inside growth chambers and rooms. How much your potted plants will increase the humidity depends on how many you have and how big they are, the volume of air inside the growth chamber or room, and your fresh air flow rate.

Humidity control options include both additive humidity (adds water vapor above ambient levels) and de-humidification (removes water vapor below ambient levels). When purchasing new or assessing existing equipment, pay close attention whether the chamber has additive humidity, de-humidification, or both. Consider plant growth goals, microbial pathogen pressure, and geographic location when deciding which humidity options to include in new equipment.

## Common examples of when additive humidity may be required include:

1. In high latitude climates during winter months, where the relative humidity inside buildings drops below 30% at room temperature (21°C).
2. Trying to maintain a steady vapor pressure deficit for an experiment with various temperature set points, especially at higher temperatures.

## Common examples of when de-humidification may be required include:

1. In seasonally or continually humid coastal or tropical climates that have high ambient dew point temperatures inside buildings.
2. Certain low temperature chambers and $CO_2$ control options require the fresh air and exhaust ports to be closed. In this situation, undesirably high humidities can build up from plant transpiration and evaporation from irrigation water.

For a more detailed discussion of humidity control, how to understand and interpret humidity specifications, and relevant humidity terms for plant growth (vapor pressure deficit), please read: How to control humidity inside growth chambers and rooms for research and optimal plant growth (https://www.biochambers.com/pdfs/vapour_pressure.pdf).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