

VPD vs. Relative Humidity

Vapor-pressure deficit is independent of temperature and is a more accurate measure to predict plant transpiration and water loss than relative humidity.

by HEIDI WOLLAEGER & ERIK RUNKLE

Greenhouse ornamental and vegetable growers manage many environmental factors in their greenhouses—sometimes including humidity. Air with a high relative humidity, greater than 85%, can provide an environment conducive for fungal pathogens because the water lost through the stomata is slowly lost to the air and, therefore, remains on the leaves.

While relative humidity is the most common way growers express the air's saturation with water, it's not the best measurement to accurately predict plant transpiration or water loss. Why?

Relative humidity refers to the amount of water vapor in the air versus what it can hold. The amount of water that air can hold varies with temperature; warmer air has a greater water-holding capacity than cooler air. The

water-holding capacity of air approximately doubles with every 20F-degree increase in temperature. Therefore, air that is at 80F (26C) can hold twice the amount of water compared with 60F (15C).

Instead of relative humidity, the more accurate way to express the driving force of water loss from a leaf is vapor pressure deficit (VPD). Its value is independent of temperature. VPD is the difference between the amount of moisture in the air and how much moisture the air could potentially hold when it's saturated. It's often measured in pounds per square inch (psi) or kilopascal (kPa). A high VPD (greater than 1.0 kPa) means that the air can still hold a large amount of water. Therefore, there's a fairly large gradient between plants (nearly saturated with water) and the

air, enabling the plants to transpire and, over time, dry out. A low VPD indicates the air is near saturation. A VPD of zero means the air is 100% saturated and thus plants cannot transpire effectively.

Growers should aim to have fairly low VPD—for example 0.3 kPa when rooting cuttings in greenhouses. This will reduce the drying of young plants, thereby reducing the frequency of misting and watering required to keep plants hydrated. However, Michigan State University Extension recommends maintaining a greater VPD (greater than 0.5 kPa) in greenhouses while finishing plants, especially when there's a dense plant canopy. Plants will be able to transpire, cool themselves and be less stressed while the environment is less conducive to disease.



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Too dry of an environment can cause problems for greenhouse vegetable growers.

When temperature is increased by 15F increments and relative humidity stays the same, vapor pressure deficit varies from 0.55 kPa to 1.45 kPa.

Temperature	Relative humidity	Vapor pressure deficit
60F (15C)	70%	0.55 kPa
75F (24C)	70%	0.90 kPa
90F (32C)	70%	1.45 kPa

When temperature is increased by 15F increments and vapor pressure deficit stays the same, the relative humidity varies from approximately 22% to 71%.

Temperature	Relative humidity	Vapor pressure deficit
60F (15C)	22%	1.38 kPa
75F (24C)	41%	1.38 kPa
90F (32C)	71%	1.38 kPa

Greenhouse vegetable growers harvesting fruits should be aware that one study, "Vapor Pressure Deficit (VPD) Effects on the Physiology and Yield of Greenhouse Tomato," reported that a VPD of 0.8 kPa during the day and night increased photosynthetic rates and tomato fruit yields compared to plants grown with a VPD of 0.5 kPa. Too dry of an environment can also cause problems. For example, another study, "High Vapor Pressure Deficit Influences Growth, Transpiration and Quality of Tomato Fruits," showed that a very high VPD of 2.2 kPa could cause plant stress and fruit cracking in tomatoes. [IG](#)

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