Lower Humidity Levels in Your Greenhouse

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The fall and spring are times when humidity related diseases usually peak in the greenhouse. Sunny days increase the transpiration of moisture from leaf surfaces and evaporation from soil surfaces. The warm air cools to the dewpoint, condensation occurs and water droplets are formed on cooler surfaces, such as the leaves and glazing. This moisture promotes the germination of fungal pathogen spores such as *Botrytis* or mildew.

There are several ways to reduce the humidity level.

Vent the Humid Air

One of the most efficient ways is to exhaust the moist air and replace it with cooler, drier outside air. The temperature of the air greatly affects its capacity to hold water vapor. Air at 70°F. will hold twice as much moisture as air at 50°F. In the range of temperatures encountered in a greenhouse, for every 20 degee rise in dry bulb temperature, the water-holding capacity of the air doubles and the relative humidity is reduced by one-half.

Applying this principle to our problem of reducing humidity, we see that if we exhaust the humid air in the greenhouse and replace it with cool, dry outside air, which when warmed in the greenhouse will absorb more moisture, we can lower the humidity.

In glass houses with vents, the heat should be turned on and the vents opened. In houses with fans, the fans should be activated and operated for a few minutes and then the heater turned on to bring the air temperature up.

This can be effective even if it's cool and raining outside. Air at 50°F. and 100 percent relative humidity (raining) contains only half as much moisture as the greenhouse air at 70°F. and 95 percent relative humidity.

What does it cost? Based on 1,000 square feet of greenhouse floor area (approximately 10,000 cubic feet of air), it would take 4,000 Btu of heat to raise the temperature of the air 20°F. (for example from 50° to 70°). At $0.75 per gallon of fuel oil or $0.52 per therm of natural gas, this amounts to about $0.03 each time the air is changed. Usually this is done two or three times per hour during the evening after the sun goes down and early in the morning at sunrise.

Although some growers leave the vents cracked open all night, it is more energy efficient to control the cycling with a time clock or humidistat. The time clock could be set to activate the vents or fan. A relay may be needed to lock out the furnace or boiler until the fan shuts off so that flue gases are not drawn into the greenhouse.

Use of Wetting Agents

On greenhouses covered with plastic glazing, the use of a wetting agent, either sprayed on the interior surface or as part of the formulation of the glazing, can help to reduce the humidity level. The moisture that condenses on the cooler glazed surfaces will remain as a film, draining to the eave or foundation, rather than forming droplets and dripping back onto the plants. Wetting agents that are part of the formulation of the glazing usually have a longer life (one to two years) than those that are applied to the surface, although surface application is fairly easy to do.

Glass greenhouses are usually designed with a steep enough roof pitch (6:12) to allow moisture to run off so that wetting agents are not needed. More condensation will occur and greater reduction in humidity will result with single glazing such as glass, with a cool inside surface, than with double glazing which has a warmer inside surface.

Air Movement

Continuous air movement helps to reduce dripping because it reduces stratification of the air. Air that is moving is continually mixed, resulting in very small temperature differences. The moisture does not get a chance to condense on the leaf surfaces, because the mixing action caused by the movement prevents the air along the surface from cooling to below the dewpoint.

When the greenhouse is heated with hot air furnaces, continuous air movement can be obtained by running the fans continuously. Some furnaces are equipped with a manual switch on the fan motor, others can be rewired by an electrician. If two furnaces are used, they should be located at opposite corners and set to direct the air in a circular pattern.

The fan-jet system can be used to move air within the greenhouse. In this system, the fan is connected to a perforated plastic tube located below the ridge. The fan is set to run continuously and either draws in outside air through a louver or recirculates air within the greenhouse. The air in the tube is forced out through the small holes and mixes with the air in the structure. Air circulation with this system is not as efficient as moving the entire air mass.

Another system that gives good air circulation and mixing is Horizontal Air Flow (HAF). Small fans (1/15 horsepower, 16 to 20 in. diameter) placed along the sides of the house push the air in one direction on one side and in the opposite direction on the other side. Fans should operate continuously, except when the exhaust fans are operating.

Measuring Humidity

If you remember back to your high school or college physics classes, the sling psychrometer was used to determine relative humidity. It is still one of the fastest and most accurate methods for determining relative humidity. This device uses two thermometers, one with a wick, contained in a holder that can be swung like a fan. Wetting the wick with water and rotating the thermometers for about a minute will give the wet-bulb and dry-bulb temperatures. After subtracting the wet-bulb temperature from the dry-bulb temperature to get the depression, the relative humidity can be determined (see Table 1). Sling psychrometers are available from greenhouse suppliers and scientific equipment stores for about $35.

The battery operated psychrometer uses a fan to blow air over the wick. One supplier is Davis Instrument Mfg. Co., 513 E. 36th St., Baltimore, MD 21218. The cost is about $120.

The recording hygrothermograph ($500 to $700) provides a continuous chart of dry bulb temperature and relative humidity. Although most older instruments used human hair as the sensing element, new instruments use other materials such as polystyrene, nylon or cellulose acetate butyrate. Accuracy of humidity readings depends on good maintenance of the sensor.

Table 1. Relative Humidity Chart

Dry Bulb Temp. °F	*Difference (°F) Between Dry-Bulb and Wet Bulb Temperatures*									
	2	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*
	Relative Humidity (percent)									
50	87	75	62	51	39	29	18	9		
52	87	75	64	52	42	32	21	12	6	
54	88	76	65	53	43	33	23	14	8	
56	88	77	66	55	45	35	26	16	10	
58	88	78	67	56	47	37	28	18	12	4
60	89	78	68	58	48	39	30	21	14	5
62	89	79	69	59	50	41	32	24	17	8
64	90	79	70	60	51	43	34	26	19	11
66	80	80	71	61	53	44	36	29	22	14
68	90	80	71	62	54	46	38	31	24	16
70	90	81	72	64	55	48	40	33	27	19
72	91	82	73	65	57	49	42	34	28	21
74	91	82	74	65	58	50	43	36	30	23
76	91	82	74	66	59	51	44	38	32	25
78	91	83	75	67	60	53	46	39	33	27
80	91	83	75	68	61	54	47	41	34	29