HORIZONTAL AIR FLOW WITHOUT CO_2

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Carbon dioxide is a very good investment on most crops in northern greenhouses. But some growers still do not provide it for their crops. If they don't, should Horizontal Air Flow (HAF) be used?

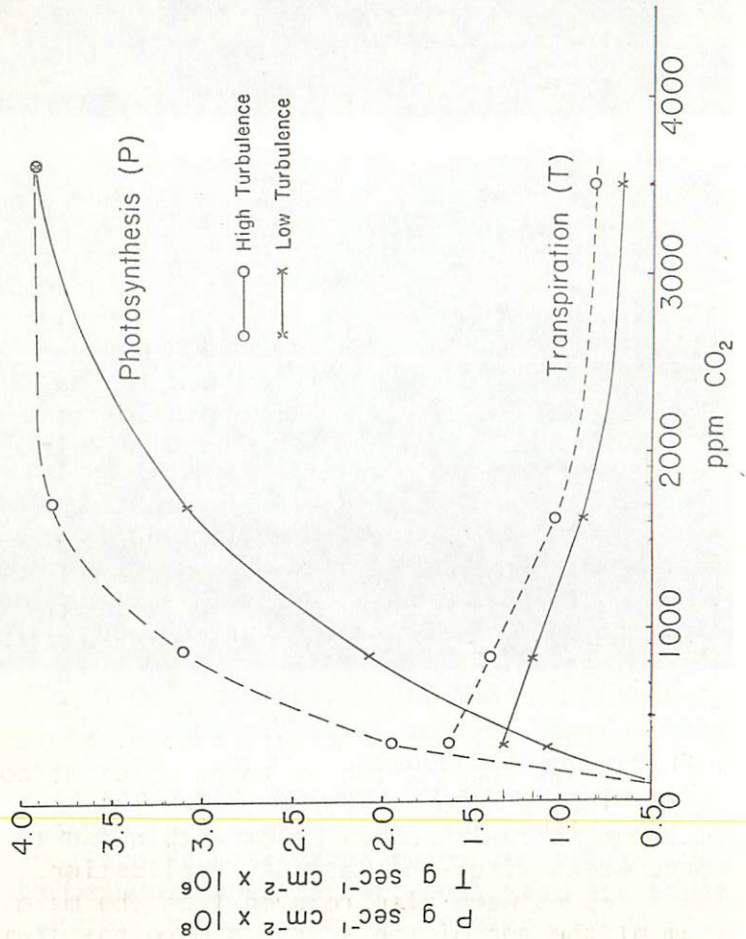
The greenhouse atmosphere is rapidly depleted of CO_2 during daylight hours. A closed greenhouse will have in excess of 350 ppm CO_2 at dawn since the plants and the soil flora and fauna have been respiring all night. With light, the plants fix this CO_2 in photosynthesis and rapidly decrease the level to 330 ppm, normal in outdoor air. The level will further decrease to below 200 ppm at which time photosynthesis is slowed to the point where some crops cease to produce as much photosynthate as they use up in respiration.

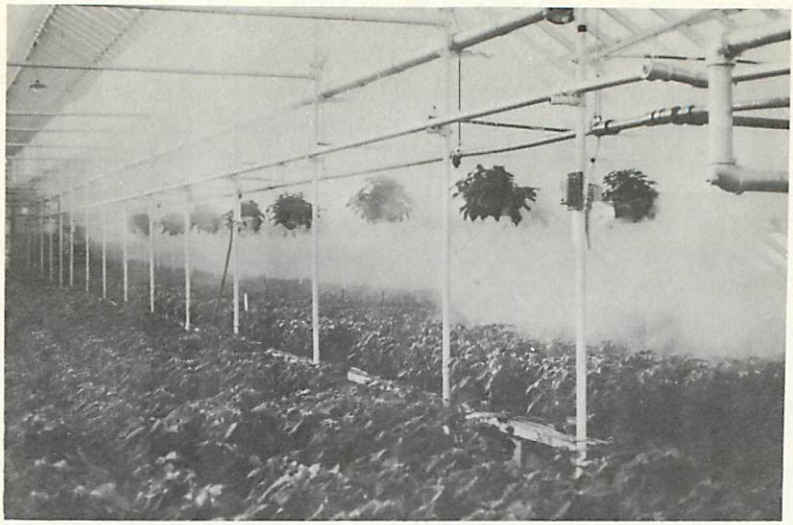
Dr. Paul Waggoner (1963) published some data on the efficiency of photosynthesis in static vs. moving air on cane. He found that it proceeded 20 to 32% faster at a CO_2 level of 200 ppm in turbulent air than it did in static air. This rate in turbulent air at 200 ppm was the same as 300 ppm in static air.

At higher levels of CO_2 the rate of photosynthesis may be increased proportionately more by air turbulence. The graph on page 15 was photocopied in the early 1960's but the source was lost. If someone recognizes the data, PLEASE LET ME KNOW.

From this graph, the increase in photosynthesis was estimated as follows:

ppm CO_2	Low Turbulence P g sec^{-1} cm^{-2} x 10^8	High Turbulence	% Increase
300	1.07	1.92	74
800	2.10	3.11	48
1600	3.08	3.83	24





Figures 1 and 2. Horizontal air flow in a single house may not be as dintinct as in gutter-connected houses. Figure 1 shows the coherent air mass moving down the right side of the greenhouse. In Figure 2 the leading edge of the returning smoke is less distinct since the jets from the HAF fans are sending some smoke ahead of the main mass of moving air. Air movement was estimated at 80 feet per minute using six 18" fans in a 178 x 42' greenhouse.

These data indicate that photosynthesis will be increased greatly by moving air at high levels of CO_2. But, equally important, is the fact that, as mentioned before, it will be increased by 19 to 32% at 200 ppm CO_2 if the air is in motion.

This reinforces the concept that CO_2 utilization is improved since the leaves are "scrubbed" by the air.

Other advantages of HAF, as reported in previous articles, include:

1. Only 1/2 to 1/3 as much power is required.
2. Moisture condensation on plants is reduced, aiding in disease control.
3. No CO_2 distribution system is required.

Waggoner, P.E., D.N. Moss and J.D. Hesketh. 1963. Radiation in the plant environment and photosynthesis. Agron. J. 55:36-39.

Other articles on HAF have appeared in this newsletter in Nos. 26 (Jan. '69), 32 (Jan. '70), 34 (May '70), 56 (Jan. '74), 87 (July '78), 91 (Apr. '79), 97 (Feb. '80), 98 (Mar. '80), 102 (Nov. '80) and 107 (Sept. '81).