# Effect of $CO_2$ Concentration on Transpiration From Roses

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Plants take up $CO_2$ for photosynthesis by $CO_2$ diffusion through the stomates into the leaves. Similarly, the same pores provide a means for water to diffuse out of the leaf, the latter the main process determining water loss. It has been known for several years that increasing the $CO_2$ concentration tends to close stomates. As the size of the pore effects $CO_2$ and water diffusion similarly, a measure of water diffusion rate will provide an indication of stomatal opening and the rate of $CO_2$ uptake. This study showed a definite effect of $CO_2$ concentration, with 1500 ppm $CO_2$ generally having the lowest diffusion rate or conversely the highest resistance to diffusion. There were distinct differences between varieties, with 'Cara Mia' and 'Love Affair' having the greatest response between $CO_2$ levels of 500, 1000, 1500 and 2500 ppm. Differences between $CO_2$ levels had no significant effect on diffusion resistance of 'Forever Yours'. The results reinforce Thompson's conclusions that 1000 to 1500 ppm is most suitable for roses, and that 2500 ppm $CO_2$ is too high.

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## Methods

The technique for measuring stomatal diffusion was described by Turner et. al. (1). Essentially, the device consists of an enclosed chamber containing a lithium chloride dew cell, the

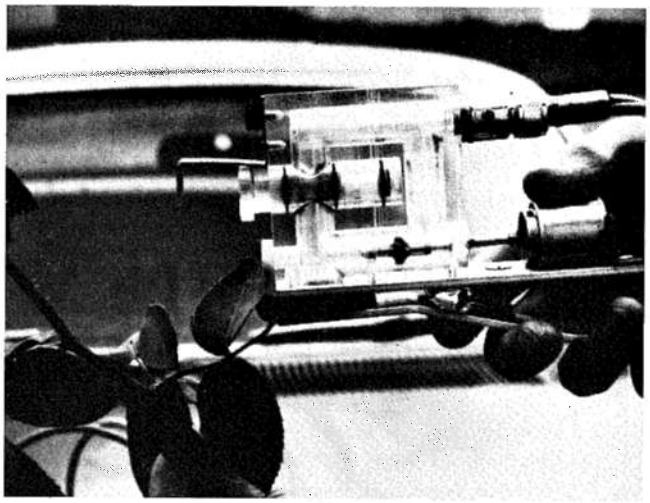

Fig. 1: Leaf clamp porometer for determining the stomatal diffusion resistance of plant leaves.

electrical resistance of which varies with relative humidity. A small fan to circulate the air, and a small chamber containing a desiccant, is included (Fig. 1). The desiccant is inserted into the chamber, and the relative humidity reduced to a predetermined level. The drying agent is removed from the chamber and the measuring device clamped on the leaf with the fan operating. As the leaf transpires, relative humidity rises to a predetermined point on a meter. The time required for the relative humidity to change is recorded. If temperature is known, the time lapse can be converted to actual units of resistance of the leaf to water vapor movement. We were content to express the results in seconds required to go from a reading of 1 to 6 on the meter. The longer the time, the slower the diffusion rate, which meant that the stomates were more nearly closed — assuming all other conditions equal.

Measurements were taken in the four $CO_2$ houses described by Mathis (CFGA Bul. 270). The varieties 'Forever Yours', 'Love Affair' and 'Cara Mia' were planted in the ground in each house. $CO_2$ levels maintained on clear days in the houses were 500, 1000, 1500 and 2500 ppm. Leaves of the same age, exposed to full sun, were utilized, with readings taken between 8:30 and 9:30 a.m. on windless days. $CO_2$ levels were checked with an infrared $CO_2$ analyzer.

## Results

The data showed that up to $CO_2$ levels of 1500 ppm, water loss from rose leaves decreased — indicating that the stomata were more nearly closed. At 2500 ppm, however, transpiration was increased (Fig. 2). There was a considerable difference between varieties (Fig. 2). The different $CO_2$ levels had no significant effect on transpiration rates of 'Forever Yours'. 'Love Affair' and 'Cara Mia', however, showed marked response to $CO_2$ level.

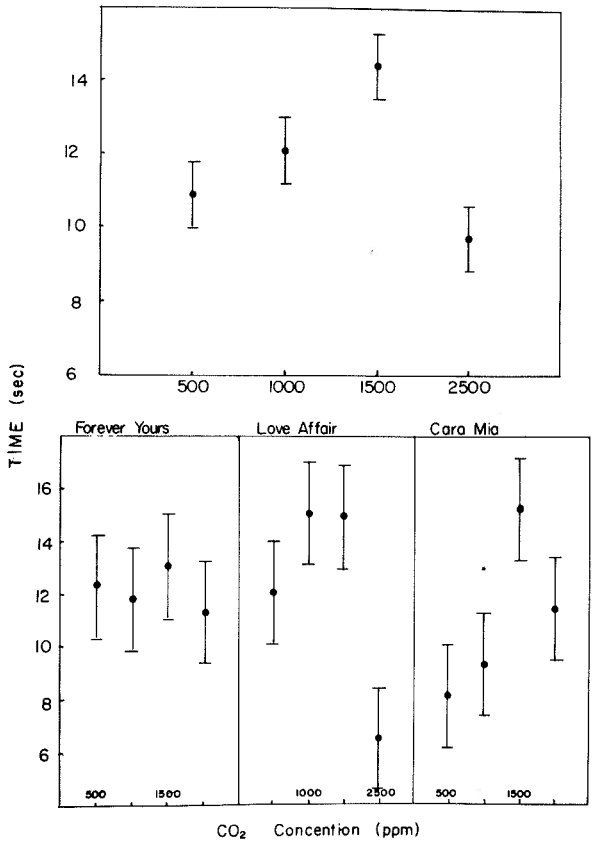


Fig. 2: Effect of $CO_2$ concentration on diffusion resistance of rose leaves.

*Upper:* Average time for all three rose varieties at four $CO_2$ levels.

*Lower:* Effect of $CO_2$ levels on water loss from leaves of 'Forever Yours', 'Love Affair' and 'Cara Mia'.

The longer the time interval, the slower the transpiration rate and the higher the diffusion resistance of the leaf to water loss. If the vertical bars do not overlap, the means are significantly different from each other.

What value is this measurement of rose behavior to us? It certainly reinforces what we have concluded from earlier work on $CO_2$ uptake — that is, 2500 ppm $CO_2$ on roses represents an excessive amount. Secondly, it provides another handle to describe varietal differences. But, both 'Forever Yours' and 'Cara Mia' are more yield responsive to $CO_2$ concentration than 'Love Affair'. So this measurement, by itself, may not be a good predictor for use in selection. Lastly, however, the more we know about how our plants behave, the more likely we are to do a good growing job.

## Literature Cited

Turner, N. C., F. C. C. Pederson and W. H. Wright. 1969. An aspirated diffusion porometer for field use. Spec. Bull., *Conn. Agric. Expt. Sta. Soils* 24/20. 14 pp.