pounds might be present in yet a third group of organisms (perhaps in cats), but for entirely different adaptive purposes.

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Saturation Deficit of the Mesophyll Evaporating Surfaces in a Desert Halophyte

Abstract. *The tensions developed in the internal evaporating leaf surfaces were estimated for a desert halophyte,* Reaumuria hirtella, *growing in its natural habitat. The method was based on the assumption that at zero transpiration the vapor pressure of the inner parts of the leaf was in equilibrium with that of the atmosphere, provided that stomatal resistance was constant during the measuring period. This could be ensured, since the measuring system controlled both the concentration of carbon dioxide and the atmospheric humidity, while measuring photosynthesis and transpiration simultaneously. Tension values of 180, 240, and 320 bars were recorded for three different* Reaumuria hirtella *plants.*

In general discussions of transpiration, the evaporating surfaces of the leaf cell walls are usually considered to be saturated. During transpiration, saturation deficits may develop (*1*), and evidence for appreciable deficits has been put forward (*2–4*). In the course of measuring transpiration, T, and photosynthesis in a number of desert plants, we developed a method of estimating the magnitude of this deficit. A halophyte, *Reaumuria hirtella*, (J. et Sp.) (Tamaricaceae), growing in natural desert conditions, was chosen for detailed studies. Measured values supported our conclusion that large saturation deficits can develop.

The principle of our method was to estimate the equilibrium vapor pressure of the external atmosphere at which the net flux of water vapor between the plant shoot and the surrounding air was zero (see *5*). Photosynthesis and transpiration were measured simultaneously throughout the day on intact plants in a natural hillslope community at the Desert Research Farm of the Botany Department at Avdat, in the Negev desert, Israel. Climatological data for this site are given in (*6*). The measuring system, operating from a mobile laboratory, has been described (*7*). This "null-point compensating system" operates on the principle of measuring rates of compensation for the changes in atmospheric composition (CO_2 and H_2O) produced in a transparent chamber by the activity of the enclosed shoot, while maintaining this composition constant.

Water vapor and CO_2 were maintained at the desired concentrations by continuous monitoring with an electric hygrometer and a recording infrared gas analyzer. Compensation for changes in the concentration of CO_2 was made by addition of CO_2-enriched air, while changes in humidity were counteracted by controlling the rate of drying of the circulating air. Leaf temperature was measured to $\pm$ 0.3°C, by inserting a thermocouple into the leaf, along its axis. Two leaves were thus measured in each plant and the mean was taken to represent that of the entire leaf population on the shoot. This appears reasonable, since the plants were small and open and were subjected to constant turbulence. Air temperature was measured by shaded thermocouples in the air outlet from the chamber.

Under constant turbulent conditions and uniform stomatal resistance, transpiration is a linear function of the gradient of water-vapor pressure between the evaporating surface and the atmosphere. If the evaporating surface is water-saturated and leaf and air temperature are equal, $T = 0$ when the vapor pressure gradient is zero, and the plotted curve of T against gradient passes through the origin. With an unsaturated evaporating surface, $T = 0$ at an atmospheric water vapor pressure less than the saturation value. For technical reasons, the equilibrium vapor pressure at $T = 0$ could not be attained in the field. This value was found by regression analysis.

In order that leaf and air temperatures would be more nearly equal, the radiation load on the plant was reduced to half by shading it with wire mesh. Transpiration values were recorded for three successive 10-minute intervals at each level of atmospheric humidity. Values used in the subsequent analysis were recorded between 10 a.m. and 3 p.m., during which period the light intensity at the plant was 5.5 $\pm$ 0.5 lumen/cm^2 and air temperature varied only by $\pm$ 2°C. The concentration of CO_2 was held constant at 320 $\pm$ 5 parts per million. Under these conditions, uniform rates of photosynthesis were taken as an indication of a constant stomatal resistance. In earlier studies with this and other species, we found quite a close relationship between change in stomatal resistance and changes in CO_2 uptake, at constant, saturating light intensities. Any transpiration values recorded during marked fluctuations in rates of photosynthesis were not included.

Linear regressions of T on atmo-

Table 1. Estimated tension values at the mesophyll evaporating surface, and mean rates of photosynthesis during the measuring period.

Plant No.	Tension (bars)	Photosynthesis (mg CO_2 min^{-1} g^{-1} leaf dry wt.)
1	320	3.77 ± 0.07*
2	180	15.50 ± .28
3	240	5.26 ± .17

* ± Standard error.

spheric relative humidity were calculated. The humidity was expressed as negative potential ($-d$) in meters of water (*8*), which has the advantage of being in absolute units as well as being corrected for different air temperatures. Leaf temperatures were either equal to or lower than air temperatures. Where leaf temperature was lower, actual transpiration values were corrected to isothermal conditions as follows. The relationship between T and vapor pressure gradient is linear—that is, T/vapor-pressure-gradient = a constant, K. A mean value for this constant for each plant was calculated from data obtained on occasions when leaf and air temperatures were equal. Where leaf and air temperatures differed, the change in saturated vapor pressure caused by this temperature

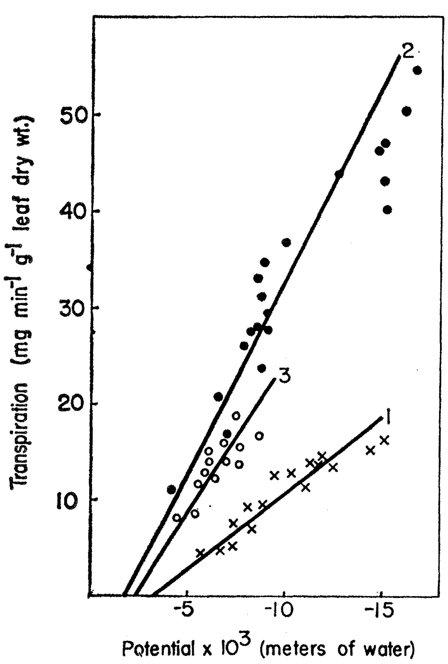

Fig. 1. Estimation of mesophyll saturation deficit in *Reaumuria hirtella* by regression analysis of transpiration rate and atmospheric water potential. The intercept on the base line measures the deficit. The correlation coefficients (r) are -0.924 for plant 1; -0.772 for plant 2; and -0.645 for plant 3.

difference was calculated, neglecting, for this purpose only, the inaccuracy introduced by assuming the evaporating surface to be saturated. The difference in gradient was multiplied by the mean constant, K, and added to the measured transpiration value. This correction greatly improved the correlations.

A major source of error in these estimations arose from inaccuracies in measurements of leaf temperature; such inaccuracies could lead to relatively large errors in the calculated vapor pressures. Since inaccuracies in measurements of mean leaf temperature amounted to ±0.3°C, the resulting variability of the estimated mean tension values for plants 1, 2, and 3, respectively (Table 1), was ±40, ±25, and ±30 bars.

Highest transpiration rates were associated with the lowest mesophyll saturation deficit (plant 2, Fig. 1). The slope of the regression lines is a measure of stomatal resistance. Again, this was lowest in plant 2, which also had a much higher rate of photosynthesis (Table 1).

The measured tension values are high (Table 1). Shimshi (*4*) has published values up to 90 bars for nonwilted maize. However, *Reaumuria* is a halophyte growing under desert conditions, with an average of 30 percent of soluble salts in the cell sap (*9*). The effect of this high salt concentration may not be confined to mere molar reduction of the saturated vapor pressure. As shown by Boon-Long (*2*), solutes may concentrate at the evaporating surface, causing a reduction in vapor pressure greater than that calculated from the concentration of the vacuolar sap. High salt concentrations may also reduce cell permeability (*2*). The physical effect of the retreat of water columns into the micro-capillaries of the cell wall (*10*) would contribute to a further reduction of vapor pressure. Though these effects combine to reduce actual transpiration, they nevertheless do not affect the estimated saturation deficits, because they are functions of the transpiration flux and would disappear at zero transpiration. The actual and theoretical lines should therefore converge to intercept the abscissa at the same point.

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Genetic Disparity and Cancer Induction by Normal Tissue Implants in Amphibia

Abstract. *Fifty percent of the implants of normal adult* Triturus cristatus *kidney made into the forelimbs of immature but postmetamorphic* Xenopus laevis *hosts initiated the formation of lymphosarcoma at the site of implantation. Donor-host genetic disparity as it relates to the intensity of the reaction, when homografts, heterografts, and xenografts are compared, appears to be one of several factors which play a role in the postembryonic induction of both lymphosarcomas in* Xenopus laevis *and accessory limb structures in* Triturus viridescens.

The African clawed toad, *Xenopus laevis*, is subject to the spontaneous development of highly lethal metastatic lymphosarcomas (*1*). The cancer forms primarily in the liver, spleen, and kidney, but will metastasize elsewhere into visceral and perivisceral regions. The organs affected are progressively destroyed. The cells of the cancer are largely lymphoblastic in appearance and frequently one finds lymphoid cells which have peripherally arranged chromatin and prominent nucleoli (*2*). The same type of cancer can be induced to form in other *Xenopus* species and subspecies (*3*), in the European newt, *Triturus cristatus* (*4*), and in other Anuran species, for example *Rana pipiens, Rana esculenta*, and *Bufo bufo bufo* (*5*), after the initial