

ON THE FOLIAR TRANSPIRING POWER OF *TILIA*

J. E. CRIBBS, COLLEGE OF EMPORIA, KAN.

ABSTRACT

Studies on the foliar transpiring power of *Tilia* were conducted during the summer of 1916 and 1917 in the dune area of northern Indiana. *Tilia* was chosen because of its unusual ability to surmount the dunes which move upon and cover large areas of mesophytic forest. In fact it is the only tree representative of the forest which displays this ability to any degree.

Five stations were selected which represented gradations in habitat; Station A. was located in a forested dune area which had become completely stabilized and contained an abundance of herbaceous undergrowth and considerable humus. Station B. was chosen at a point near the edge of the forested dune and was partly exposed to the wind. Station C. was at the very edge of the forest and was also located at the edge of a blowout where the humus had been largely removed. Station D. was on the lee side of an advancing dune where the exposure, especially to the sun, was very great, and where there was no humus. Station E. was situated at the top of a high dune which was

exposed to wind from all directions, and to the sun throughout the day. This represented the most xerophytic type of habitat available upon the dunes.

Transpiration readings were recorded by means of the cobalt chloride hygrometric paper. Correlative readings were taken of atmospheric temperature, relative humidity, direct evaporating power of the air, soil moisture, soil temperature, and wilting coefficient. These were measured that the true relation of the relative mesophytism of the stations might be better understood, and that their relation to the foliar transpiring power might be expressed.

It was found that the transpiring power at station A. was less than that of any other station, and the water loss at station E. was the greatest. Stations B, C, and D, showed an increase over A. which was directly proportional to the increase in xerophytism.

Transpiration was most rapid at the stations where the lowest average soil water and the most xerophytic leaf structures were found.

It was discovered that the amount of soil moisture had no appreciable effect upon the transpiration stream except when the wilting coefficient of the soil was approached.

Light, wind, and relative humidity were the factors which most strongly influenced the fluctuation of the current. The transpiration index was found to rise very rapidly just after dawn, and more rapidly upon the open sands than in the shaded forest.

A "saturation deficit" was developed in most instances and was much more in evidence upon the open dunes than in the forest. In fact in the forest the deficit did not appear in many of the readings, especially when the day was cloudy and the relative humidity high.

Although the saturation deficit was very strongly developed upon the open sand, there was never any visible evidence of wilting there. In the early summer the soil water content in

*A more extended report of the work on *Tilia* appeared in Bot. Gaz. 68: 262-286. 1919. "Comparative Studies of the folia Transpiring Power."

the forest was much greater than that of the open dune areas, but in the fall visible wilting became evident in the former of these situations where it was found that the water had been reduced to the wilting coefficient. This was evidently due to the presence of a vegetation so abundant that its demands for water could not be met by the sand which holds a much smaller amount of available water than any other type of soil. Further evidence of this was noticed upon the open sand where there was no visible wilting at any time. Although the available water for plant growth is always low there, the demand made upon it is of course almost negligible because of the sparsity of plant growth.

More rapid water loss upon the open sand as compared to the low rate for the forest, was quite different from the findings of previous investigations made upon desert plants by Bakke,¹ Livingston, and Shreve.² These investigators report a very low index for the various desert xerophytes studied. In fact the first named author has suggested as a criterion for the mesophytism of a plant its foliar index of transpiration; and in the suggested scheme the mesophyte should show the highest index and the xerophyte the lowest. Intergradations in the scale would indicate different degrees of mesophytism. Yet in the work upon *Tilia* it was found that such an application would prove misleading because the transpiration current is very much greater in the most xerophytic habitat than in the established dune forest which is certainly the most mesophytic of the five situations, and the leaf structure in the former of these habitats is undoubtedly much the more xerophytic.

It will be recognized, however, that the situation in the case of *Tilia* is different from that in the investigations of the above named authors.

They were investigating transpiration of certain xerophytes which were growing in their normal environments. This is rather an instance of a species making a rapid correlation to a forced environment; and although the assumed xerophytism

¹ Bakke, A. L. Studies on the Transpiring power of plants as indicated by the method of standardized hygrometric paper. Jour. Ecol. 2: 145-173. 1914.

² Livingston, B. E., and Shreve, Edith B. Improvements in the methods of determining the transpiring power of a plant surface of hygrometric paper. Pl. World. 19: 287-309. 1916.

of leaf structure is indicative of considerable plasticity, yet the correlation in structure has not been proportional to the variation in environment, from a normal mesophytic to an abnormal xerophytic one. In other words the response to external influence lags behind the causal factors to a considerable degree.