Measuring the Water Given Off by Plants

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If you were asked to name the biggest single problem facing the Southwest today, what would your answer be? Many of you probably would not think of water, because plenty of good water appears when we open the valve, and we have grown to take it for granted. Nonetheless, maintaining an adequate supply of water for crop production, domestic use, manufacturing, etc., is and will be increasingly the biggest problem our rapidly developing Southwest has to solve.

There are several possible sources of water — pumping from the Colorado River, desalting Pacific Ocean water, seeding clouds to produce rain, and increasing water production of our forest and rangeland watersheds. The last possibility is the most promising. It is safe to say that less than ten per cent of the rain that falls ever reaches a reservoir or valley water-table. If we want to increase this percentage a little, we must study our watersheds.

Lost Through the Leaves

It is well known that plants use tremendous amounts of water. Perhaps half of the water lost from a watershed is evaporated from the leaves of plants — a process called transpiration. We know that some types of plants transpire greater quantities of water than others.

The College of Agriculture's Watershed Management department is studying different plants to determine not only which plants transpire the greatest quantities of water, but what environmental influences affect transpiration the most. Is it the intensity of radiant energy from the sun? Is it the amount of water vapor already present in the air? Is the temperature of the air or the leaves important? What effect does the wind have? How much influence is exerted by the soil as it becomes drier because water is being removed? All these factors play a part in transpiration, but their relative importance is not clearly understood.

To help answer some of these questions, an experimental device was built. It consists essentially of a plexiglas chamber equipped with an electric instrument that measures humidity very accurately — a hygrometer. When the chamber is placed over a plant, the hygrometer measures the increase in humidity as the plant throws off water vapor. By measuring an increase of two or three per cent relative humidity, we can get the amount of water given off by the plant without disturbing its environment.

Measuring Is Tricky Business

These measurements cannot be made continuously, because if the plant were left in the chamber, it would go on transpiring until the humidity in the chamber approached 100 per cent. It is obvious that evaporation into a wet atmosphere is less than into a dry one, and our measured transpiration rate would be lower than it is in the field.

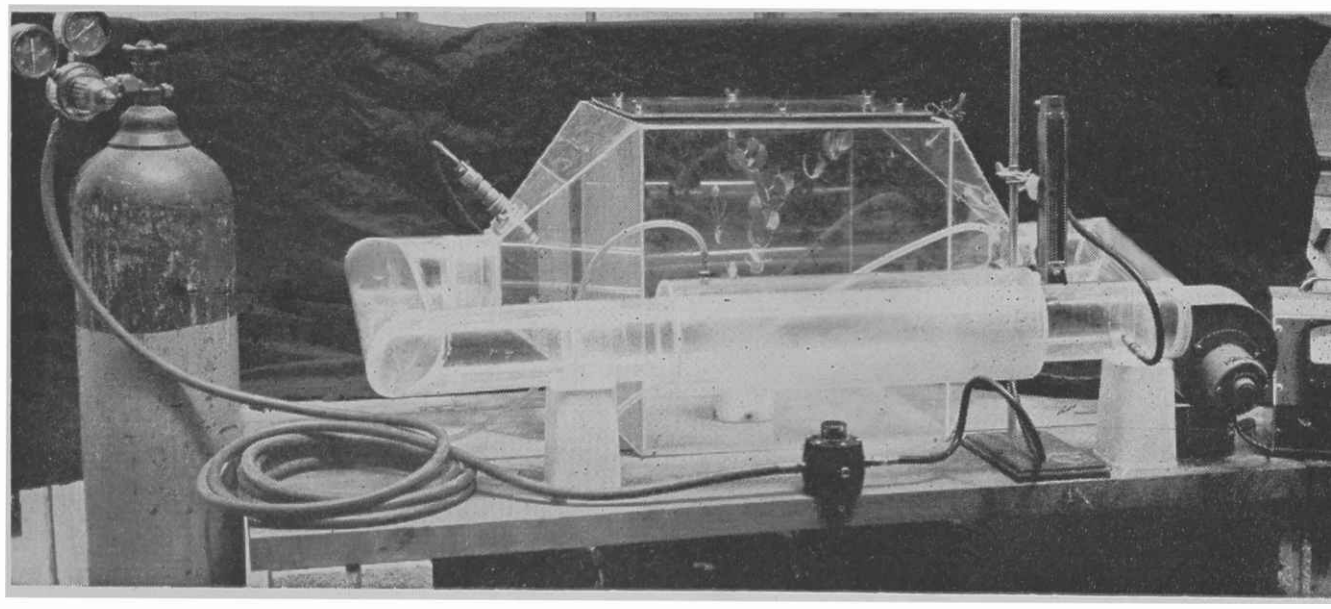
To make continuous measurements of transpiration we circulate the same air around and around through the chamber with the blower shown in the lower right corner of the picture. We measure the humidity with the hygrometer (the instrument in the lower right side of the picture. It is attached by a cable to the sensing element in the left side of the chamber). By adding dry air from the tank to the circulating stream of air, we offset the water given off by the plant and maintain constant humidity. A jacket of cold water around the air-stream keeps the temperature constant as well. With this set-up, transpiration can be measured for long periods of time.

By measuring transpiration rates when all factors are kept constant except one, we can measure the influence of one factor at a time.

Complex — But Important

Unraveling the close inter-related factors that affect transpiration is a complex task, but it is the key to understanding the process as a whole. And understanding transpiration is important, because the more we know about it, the more accurately we can predict where vegetation changes on a watershed can increase the yield of forage and clear water without erosion.

BELOW, a view of the intricately constructed plexiglas chamber in which the transpiration rate of a young jojoba plant is being measured.



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