Leaf water repellency

Environment, Water

Cloud forests are characterized by photosynthetic capacity which may be increased by reduced water retention of the leaf. The reason is that carbon dioxide diffuse air faster than water. The article “ Leaf Water Repellency as an Adaptation to Tropical Montane Cloud ForestEnvironment” by Curtis D.

Holder examines lead water repellency in three ecosystems of Guatemala: a tropical dry forest, tropical montane cloud forest and temperate foothills-grassland zone. The author’s hypothesis that cloud forest zones are characterized by higher leaf water repellency failed to be proved as leaf water repellency appeared to be higher in tropical dry forests and temperate foothills- grassland zone.

Water repellency is defined as adaptation on the surface of the leaf in habitants which are constantly subjected to daily precipitations during the period of active growth. Holder assumes that leaf water repellency is lower in open-meadow habitants than in dry forest habitants simply because dew formations are occurring faster.

Moreover, water repellency of any leaf is driven, primarily, by physiological factors. In wet zones the plants are claimed to be selected due to their water shedding abilities as they have to able to defend their stomatal pores and to enhance photosynthesis abilities after fog interception. Decrease in water repellency may result in increased disease rates, although it doesn’t affect selective traits.

Holder argues that it is natural selection that predetermined water repellency on leaf surface in cloud forest zones. Fog droplets negatively affect water repellency as they prevent gas exchange in plants. In such a way, photosynthetic carbon exchange is prevented by fog droplets as carbon dioxide diffuse air faster than water.

Leaves with high water repellency minimize the leaf surface and promote the beading of water assisting gas exchange processes. In cloud forest zones, high leaf water repellency increase photosynthesis efficiency. Holder stresses that leaf water repellency " is measured by calculating the contact angle between a droplet of water and leaf surface". (p. 767)

As it is mentioned above, the paper examines three distinct areas and central thesis is that high water repellency is inherent for plants in cloud forest zones as plants are more able to maximize photosynthesis and gas exchange process. Three areas were chosen to test leaf water repellency: Sierra de la Minas, Chiquimula and Colorado. Firstly, leaf water repellency was testified near Sierra de la Minas in lower cloud forest zone.

This region is characterized by humid slopes on the windward side and, consequently, slopes on the leeward side. Strong northern winds are prevailing in that region. Night temperatures are about 5-15 degrees all year round. Also, Sierra de la Minas is characterized by variable precipitation – rainy season is observed from May till October. Fogs are more common in dry season, rather than in wet one.

Secondly, leaf water repellency was examined in Chiquimula which is situated in 75 km from Sierra de la Minas. Leaves were tested on the leeward side of the region and were selected from dry forests. The precipitation rate is 1050 mm occurring from May till October. The temperature range is 22-26 degrees.

Thirdly, water repellency was tested in leaves in Colorado, in particular, near the campus of the University of Colorado. Mainly, Colorado is temperate foothills-grassland zone. Selected species are dormant plants tested in the coldest months.

Summing up, all species were chosen from the three distinct regions as they had managed to survive to maturity in their climatic conditions. Researches gathered only leaves which received equal amount of sun light and shade as it would allow more accurate examination. Leaves were dried with filter paper and than were fastened to a wood platform to view the horizontal profile of the leaf.

The test aimed at identifying the differences between adaxial and abaxial sides of the leaf in terms of water repellency. Holder specifies that “ in the experimental design using nested analysis of variance, species were nested within study sites, leaves were nested within species, and leaf surfaces were nested within leaves”. (p769)

The results contradict the initial hypothesis and showed that as leaf water repellency appeared to be higher in tropical dry forests, not in cloud forest ecosystem. Species chosen from Sierra de la Minas region appeared to have the lowest water repellency, whereas species retrieved near the University of Colorado proved to have the highest water repellency.

The leaf water repellency appeared to be significantly different in the three distinct regions. Sierra de la Minas' species differed from those in Colorado and Chiquimula, and water repellency in Chiquimula differed from that in Sierra de la Minas and Colorado. It proves that leaves in different climatic zones can't have similar water repellency as they have different levels of adaptations.

Holder stresses that cloud forests are characterized by reduced capabilities to photosynthesis because of abaxial leaf wetness and constant cloud cover not letting the sun in. Therefore, leaves in this region should develop adaptation capabilities as it would allow maximizing photosynthesis processes in the most humid regions. In cloud forests the productivity of ecosystems is limited.

The author concludes that, despite his expectancies, cloud forests aren't characterized by high leaf water repellency and, therefore, leaves are less able to minimize the water content on their surfaces. As a result, photosynthesis is decreased. Higher leaf water repellency in Chiquimula and Colorado is related to increased soil moisture and water balance in plants. High water repellency may increase fog precipitation and flow of steam leading to greater hydrological inputs. Summing up, leaf water repellency is plays crucial role in hydrological processes.

References

Holder, Curtis D. (2007). Leaf Water Repellency as an Adaptation to Tropical Montane Cloud Forest Environment. Biotropica, 39, 6, 767-770.