Innovative Vapor Condenser Inspired by Bromeliad Plant

Triphetprapa, Sureeporn
Komkla, Kanjana
Phianchat, Thidarat

Water deficiency causes various agricultural problems in many areas of Thailand. We observed that the bromeliad plant (Aechmea aculeatosepala) can grow in dry areas because its leaves can converse air moisture into water droplets and preserve them in its reservoir. In this study, we aim to mimic the leaf structures of bromeliad to condense air moisture into water. This water is helpful for the agriculture and also for self-watering of plants. The bromeliad leaves have special surfaces that are cooler than the surrounding, allowing the mist to easily condense into droplets on the surfaces. Many droplets on a leave gather into a bigger drop due to the leaf convex shape and rapidly draining into the plant's reservoir because the leaf hydrophobic surfaces. Under the microscope, the surface cells are formed into many groups. Each group looks like a disk, so-called tricomes, whose edge raises up to make the water droplets not adhered to the surface. In our previous prototype, this amazing bromeliad leaf is mimicked using aluminum plates because of its low heat capacity and its availability. This low heat capacity makes it cooler than the ambient temperature. In our current prototype, this cooling capability is enhanced by insertion of sand in between two layers of the aluminum plates. Moreover, the upper surface is coated by Teflon for its hydrophobic property. Our vapor condenser is tested in different ambient humidities and the volumes of captured water are compared. The current prototype can capture 14 ml of water in 12 hours (6 pm to 6 am), compared to 7 ml of the previous version. Other methods to keep soil moisture are also used to prevent water evaporation in order to improve planting condition.

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