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AN AUTONOMOUS PLANT GROWING MODULE FOR A CUBESAT

Abstract

We developed an autonomous biological experiment into a 2 unit (2U) incubator built to become a payload of a 3U Cubesat nanosatellite. This prototype incubator weight less than 1.5kg and it has a low energy consumption. Its TiO2 based ethylene scrubber removed all the plants ethylene production. This payload contained seeds of Medicago truncatula which is a model for leguminous plants. It worked for 62 days before the experiment was terminated. The whole experiment was monitored by sensors and artificial lighting was realized with red and blue LEDs. Germination of scarified seeds gave the highest quantity of plantlets in 7 days after the rise of dormancy. A design of experiments split into 2 series and varying temperature, CO2 concentration and lighting duration was carried out in spacious incubators for the determination of growth parameters. The second series at 29.5C, 380ppm CO2 and 20h/4h photoperiod gave the best leaves productivity and total biomass regardless the photoperiod applied. These parameters were used in the 2U incubator with a temperature of 26C to test performance of the prototype giving the germination and growth of 2 big plants. A model based on the second series was developed to determine the fresh weight biomass of the plants by using measurements of visible plants functional traits. This model was successfully tested on the 2U incubator experiment allowing an accurate determination under 20