



National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Environment

Passive Nutrient Delivery System (POND)

Water and nutrient delivery for controlled agriculture environments

Reliable seed germination and plant production requires an environment that is neither too dry nor too wet. POND was developed to improve water and nutrient delivery for plants grown on the International Space Station (ISS). The technology uses an innovative wicking material to passively link a water/nutrient reservoir to a growth cylinder where seeds are germinated and plants are produced. POND addresses limitations with existing ISS plant-production technology by providing consistent delivery of water/nutrients, improving oxygen transfer to plants, and allowing users to determine how much water is being applied.

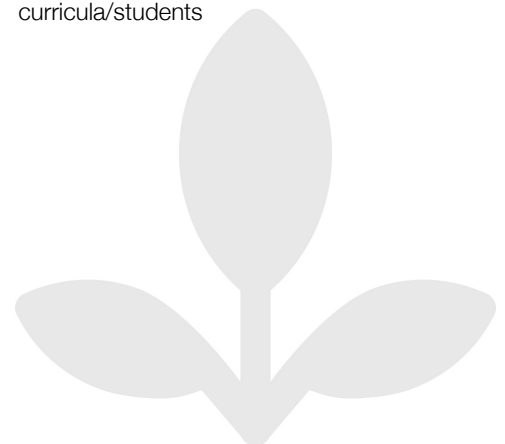
BENEFITS

- Effective: prevents issues with over- or under-watering of plants in controlled-growth environments
- User-friendly: allows user to monitor water levels
- Versatile: can be used in 1-g or microgravity environments, and can be sized to accommodate either smaller or larger plants
- Simple design: can be constructed using commercial-off-the-shelf components

APPLICATIONS

The technology has several potential applications:

- Controlled Environment Agriculture (CEA): commercial- or consumer-based indoor farming
- Education: tool for science, technology, engineering, and mathematics (STEM) curricula/students



THE TECHNOLOGY

PONDS was developed as a water/nutrient delivery system for the Vegetable Production System, called VEGGIE, on the International Space Station (ISS). PONDS uses an innovative wicking material to passively link a water/nutrient reservoir to a plant cylinder. The system enables higher germination rates and improved growth conditions compared to the VEGGIE water/nutrient delivery system currently used on the ISS.

PONDS consists of two primary components: a water/nutrient reservoir (Figure 1), and a detachable plant cylinder containing growth substrate and wicking material (Figure 2). The reservoir includes a viewing window that allows the user to observe and record water-use data. The plant cylinder, which screws into the reservoir system, is made from commercial-off-the-shelf materials and fittings. Both the reservoir and plant cylinder include oxygen-permeable windows to enhance aeration to the root zone.

Water is delivered from the reservoir to the substrate contained within the plant cylinder via the wicking material inserted into the growth substrate. The wicking material is intrinsically hydrophilic, providing improved capacity compared to the system previously used with VEGGIE. As a result, PONDS can continuously supply water to the root zone within the plant cylinder on demand.

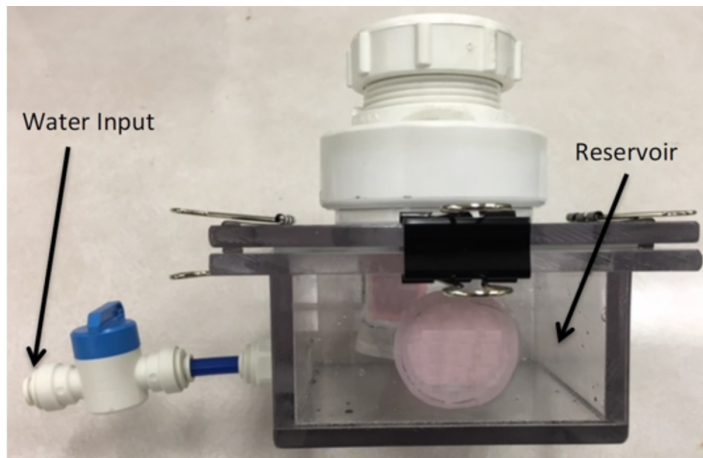


Figure 1. Early prototype of PONDS water/nutrient reservoir showing water input tubing and oxygen permeable windows.

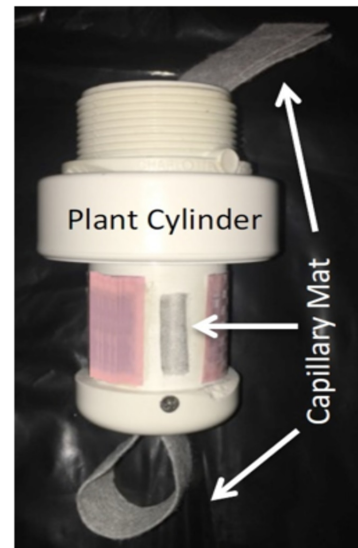


Figure 2. PONDS plant cylinder with wicking material (labelled as Capillary Mat).

PUBLICATIONS

Patent No: 10,945,389