

Media effects on lettuce growth in “pillows” designed for the VEGGIE spaceflight growth chamber

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VEGGIE is a prototype vegetable production unit for space designed by Orbital Technologies Corporation that is being developed to fly on the International Space Station. A modular plant rooting system “pillow” is being designed to support plant growth in VEGGIE under microgravity conditions. VEGGIE pillows are small self-contained packets of media with time-release fertilizer that can wick water passively from a root mat reservoir. Seeds are planted in pillows and the entire root system of a plant is contained as the crop develops, preventing loss into the spacecraft cabin. This study compared five media types and three lettuce cultivars in pillows growing in a VEGGIE analog environment. Media consisted of a peat-based potting mix (Fafard #2, Conrad Fafard Inc., Agawam, MA), and a calcined clay, (arcillite, 1-2 mm sifted, Turface Proleague, Profile LLC, Buffalo Grove IL) as well as three different blends of the two, 70:30, 50:50, and 30:70. Lettuce cultivars tested were ‘Sierra’, a bi-colored French crisp Batavia lettuce, ‘Outredgeous’, a red romaine lettuce and ‘Flandria’, a green butter head variety. Plants were grown for 28 days, harvested, biometric data was obtained, and tissue mineral analysis was performed. For all cultivars, lettuce plants grown in the media blends were more productive than those in the individual media types. All cultivars showed bell-shaped curves in response to increases in arcillite / decreases in Fafard #2 for leaf area, fresh, and dry mass. Plants in 100% Fafard #2 and in 100% arcillite were stunted, but only those in higher levels of Fafard #2 (70% and 100%) had reduced shoot percent moisture, possibly indicating that mechanisms causing stunting differed. Variation in tissue nutrient content are consistent with this, with Mg and Mn highest in plants grown in 100% Fafard and decreasing as the concentration of arcillite increased. Color also varied with media, especially in the ‘Sierra’ lettuce, with plants grown in increasing levels of Fafard #2 being much more red and those in 100% arcillite almost completely green. The red-leaf cultivar ‘Outredgeous’ showed increasing chlorophyll (SPAD values) with increasing percentage of arcillite. In all cultivars tested it appears that a mixture of media types, usually 50:50 or 30:70 Fafard #2: arcillite, sustained healthier, more productive plants. Smaller, less productive plants in either of the individual media may indicate stress issues, however more work is needed to understand the reasons for this sub-optimal growth. This work was supported by NASA.