Methods

Site description and sample collection

Samples were collected from a site located on land managed by the Bureau of Land Management on the Colorado Plateau in southeastern Utah, USA (38° 38’07.87” N, 109° 46’30.36” W). This region receives 219 mm of annual precipitation, mostly occurring as winter snow, early spring rain, and late summer monsoons, and has a mean annual temperature of 14.4 degrees C (McHugh et al. 2017, Choi et al. 2021). Ecological site description was Utah Juniper, blackbrush and vegetation was a mixture of C3 and C4 bunchgrasses (Achnatherum hymenoides, Pleuraphis jamessii), annual grasses (Bromus tectorum, Salsola tragus), woody shrubs (Coleogyne ramosissima) and trees (Juniperus osteosperma). Biocrust was a dominant ground cover and comprised of cyanobacteria, likely Microcoleus spp. and Scytonema spp. (Garcia-Pichel et al., 2001, Couradeau et al. 2016) and mosses (Syntrichia caninervis). The soil type was a fine sandy loam from the Begay-Rizno complex (USDA Web Soil Survey).

We collected biocrust samples on April 3, 2019 for our first experiment and again on June 12th, 2019 for our second experiment. We collected samples from two biocrust types occurring within a 400 m2 area: darkly pigmented cyanobacteria dominated biocrust, likely comprised of Microcoleus vaginatus and Scytonema spp., (Couradeau et al. 2016) and moss dominated biocrusts, consisting of Syntrichia caninervis. We collected samples by inserting a 10 cm diameter x 10 cm length plastic collar into the ground, excavated around it, and sliding a flat metal tray beneath the collar to extract the biocrust and soil column intact. We brought the biocrust samples to a greenhouse at the U.S. Geological Survey Southwest Biological Science Center in Moab, UT, USA. Samples were kept in the greenhouse for one week before the experiments began. Maximum temperature in the greenhouse over the course of our experiments ranged from an average of 30 °C in April to 40°C in July, which is similar to maximum outdoor air temperature. Relative humidity (RH) peaked at 49% in April, which was about 6% higher than relative humidity outside of the greenhouse (Supplemental Methods 1).