Shrubs have a greater influence on the nonstructural carbohydrates of desert mosses along precipitation decreased

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Abstract

Biological soil crusts and the mosaic distribution of vascular plants have become an important landscape feature on the desert surface owing to limited water. The desert shrub, as one of the best-known vascular plants, exerts a notable influence on multiple facets, encompassing the growth and development of biological soil crusts as well as the coverage, biomass, physiology, and biochemical properties of mosses. Therefore, to comprehend how plants react and adapt to drought conditions, it is necessary to investigate

the concentration and allocation patterns of nonstructural carbohydrates (NSCs). Nevertheless, the phenomenon still remains unclear whether the influence of shrubs on biological soil crusts follows any pattern concerning the alteration in precipitation gradients on a broader spatial scale. In this investigation, *Syntrichia caninervis* was gathered from two distinct microenvironments within the Gurbantunggut Desert spanning the gradient of natural precipitation. The aim was to examine the reaction of NSCs within *S. caninervis* to the presence of shrubs under varying precipitation circumstances. The amount of total NSCs and their components in *S. caninervis* were determined by the shrub effect, mean annual precipitation (MAP), and mean annual temperature (MAT). The presence of shrubs led to a remarkable rise in the content of fructose, starch, and total NSCs in *S. caninervis*, but a decline in the ratio of soluble sugar to starch. Nonetheless, variations were observed in the overall NSCs content, the individual constituents of NSCs, and the proportion of soluble sugars to starch within *S. caninervis* across diverse microenvironments and sampling locations. The content of total NSC and its components, as well as the ratio of soluble sugar to starch, substantially increased with a decrease in MAP (negative correlation) in *S. caninervis*. Conversely, they significantly decreased as MAT decreased (positive correlation). With the amplifying MAP, the disparities in these parameters (total NSC content, its components, and the ratio of soluble sugar to starch) between two distinct microhabitats diminished gradually, whereas these disparities progressively intensified with rising mean annual temperature (MAT). The outcomes derived from the structural equation model (SEM) underscored the direct and indirect influence of climate and the presence of shrubs influenced the content of NSCs directly or indirectly by enhancing soil nutrients. As a conclusion, the impact of shrub presence, followed by mean annual precipitation (MAP), had the most notable effect on NSCs in *S. caninervis*. Consequently, despite the observed spatial pattern in NSCs content, shrubs emerged as the most critical factor, in speaking of their effect continuous raising with the declining MAP. These findings provide new insights into the mechanisms of NSCs distribution and stress resistance in desert moss in different microhabitats.