Differential use of large summer rainfall events by shrubs and grasses: a manipulative experiment in the Patagonian steppe

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Abstract:

Abstract In the Patagonian steppe, years with above-average precipitation (wet years) are characterized by the occurrence of large rainfall events. The objective of this paper was to analyze the ability of shrubs and grasses to use these large events. Shrubs absorb water from the lower layers, grasses from the upper layers, intercepting water that would otherwise reach the layers exploited by shrubs. We hypothesized that both life-forms could use the large rainfalls and that the response of shrubs could be more affected by the presence of grasses than vice versa. We performed a field experiment using a factorial combination of water addition and life-form removal, and repeated it during the warm season of three successive years. The response variables were leaf growth, and soil and plant water potential. Grasses always responded to experimental large rainfall events, and their response was greater in dry than in wet years. Shrubs only used large rainfalls in the driest year, when the soil water potential in the deep layers was low. The presence or absence of one life-form did not modify the response of the other. The magnitude of the increase in soil water potential was much higher in dry than in humid years, suggesting an explanation for the differences among years in the magnitude of the response of shrubs and grasses. We propose that the generally reported poor response of deep-rooted shrubs to summer rainfalls could be because (1) the water is insufficient to reach deep soil layers, (2) the plants are in a dormant phenological status, and/or (3) deep soil layers have a high water potential. The two last situations may result in high deep-drainage losses, one of the most likely explanations for the elsewhere-reported low response of aboveground net primary production to precipitation during wet years.

Keywords:

Key words Patagonian steppe · Water stress · Percolation · Aboveground net primary production