

Sporadic rain events that occur during summer play an important role in the initiation of biological activity of semi-arid grasslands. To understand how ecosystem processes of a buffel grass (*Cenchrus ciliaris* L.)-dominated grassland respond to summer rain events, an LI 6 400 gas exchange system was used to measure the leaf gas exchange and plant canopy chambers were used to measure net ecosystem CO₂ exchange (NEE) and ecosystem respiration (R_{eco}), which were made sequentially during periods before rain (dry) and after rain (wet). Gross ecosystem photosynthesis (GEP) was estimated from NEE and R_{eco} fluxes, and light use efficiency parameters were estimated using a rectangular hyperbola model. Prior to the monsoon rain, grassland biomass was non-green and dry exhibiting positive NEE (carbon source) and low GEP values during which the soil water became increasingly scarce. An initial rain pulse (60 mm) increased the NEE from pre-monsoon levels to negative NEE (carbon gain) with markedly higher GEP and increased green biomass. The leaf photosynthesis and leaf stomatal conductance were also improved substantially. The maximum net CO₂ uptake (i.e., negative NEE) was sustained in the subsequent period due to multiple rain events. As a result, the grassland acted as a net carbon sink for 20 d after first rain. With cessation of rain (drying cycle), net CO₂ uptake was reduced to lower values. High sensitivity of this grassland to rain suggests that any decrease in precipitation in summer may likely affect the carbon sequestration of the semiarid ecosystem.