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C, N and P ratios modulate the dominance of soil N forms, microbial N transformation processes and microbial functional diversity under biological soil crust in a semi-arid grassland.

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The biogeochemical cycles of carbon (C), nitrogen (N), and phosphorus (P) modulate the primary production, respiration and decomposition from molecular to global scales on Earth, and constrain organismal responses to global change. Human activities are changing the ratios of those nutrients on soil, but our knowledge about how these cycles modulate key soil processes in drylands is still scarce. In these systems, open spaces between plant canopies are frequently occupied by biological soil crusts (BSCs), which influencesome N cycle processes such as N fixation, nitrification and denitrification, although their effects on the P cycle are poorly known. In this work, we have focused on how different N, C and P ratios may affect the N forms,the dominance of different microbial processes and the microbial functional diversity in dryland soils. We collected soils with and without BSCs from a semi-arid Stipa tenacissima grassland. Soil samples were incubated under 8 different treatments of N,C and P in a full experimental design (Control, N, C, P, N+C, N+P. P+C, C+N+P), and for 4 different periods of incubation (1-to-4 weeks). Changes in soil dissolved organic nitrogen (DON), ammonium, nitrate and total available N, as well as, deploymerization, nitrification and ammonification rates were monitored. Relative dominances were calculated for both N forms and microbial processes. In parallel, microbial functional diversity was estimated for the eight nutrient treatments and for two incubation periods (1 and 3 weeks) by using the Microresp technique. Along the different incubation periods, nitrate was the main dominant N form for the control, N and P treatments; ammonium dominated the C+N treatment, and DON the C and C+P treatments. Relative nitrification rate was the dominant process for the control, N and P treatments throughout the different incubation periods. A mixture of N-forms and processes dominance was found for all other nutrient treatments. Differences between microsites were not significant for nitrate, ammonium, nitrification and ammonification, but they were for DON and depolymerization rate. Total available N was constant along the period of incubation for the Control, N, P and P+N treatments but not for the C+P, C, C+N, C+N+P, decreasing between 2 and 3 times respectively. The lowest Shannon-Weaver Diversity index was found for the P, N and P+N treatments. Our results suggest that changes in N:P:C ratios will affectthe form of available N for plants and soil microbes, as well as the microbial funtional diversity of these dryland soils.