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Birational toggling on Gelfand-Tsetlin patterns appeared first in the study of geometric crystals and geometric Robinson-Schensted-Knuth correspondence. Based on these birational toggle relations, Einstein and Propp introduced a discrete dynamical system called *birational rowmotion* associated with a partially ordered set. We generalize birational rowmotion to the class of arbitrary strongly connected directed graphs, calling the resulting discrete dynamical system *the R-system*. We study its integrability from the points of view of singularity confinement and algebraic entropy. We show that in many cases, singularity confinement in an *R*-system reduces to the Laurent phenomenon either in a cluster algebra, or in a Laurent phenomenon algebra, or beyond both of those generalities, giving rise to many new sequences with the Laurent property possessing rich groups of symmetries. Some special cases of *R*-systems reduce to Somos and Gale-Robinson sequences. (Received September 22, 2017)