Plants employ the Calvin-Benson cycle to fix atmospheric CO2 for the production of biomass. Toward the development of sustainable agriculture and biofuels, increasing the efficiency and productivity of photosynthesis is crucial. Under current conditions, the flux of carbon through the Calvin cycle is limited by the activity and selectivity of ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO). Attempts to engineer RuBisCO kinetics more favorable to agriculture have led to only moderate success. In nature, alternative, RuBisCO-independent pathways to fix CO2 exist but occur only in bacteria or archaea. The purpose of this study is to implement such a carbon fixation pathway for the use in green plants. This pathway is a carbon-fixation cycle inspired by the metabolisms of bacterial autrotrophs: a condensed, reverse TriCarboxylic Acid (crTCA) cycle. The crTCA cycle operates with five bacterial enzymes that utilize endogenous plant metabolites as carboxylation substrates while using 20% less energy per CO2 capture compared to the Calvin cycle. The crTCA cycle functions in vitro under aerobic conditions, successively incorporating carbon to generate product while re-generating substrate. crTCA enzymes also have been demonstrated to retain activity when transiently expressed in plant systems. We use stable, chloroplast-localized expression of the crTCA cycle in Camelina sativa to assess changes in photosynthetic parameters. Transgenic crTCA lines have increases in CO2 assimilation rates, greater efficiency in electron usage, and differences in morphology compared to WT plants. The focus of this work is to establish that supplementing endogenous photoassimilation with synthetic pathways can be a viable approach to increasing plant productivity. Future work will develop an understanding of how this engineered pathway contributes to endogenous plant metabolism. This research is funded by the Department of Energy (ARPAe AR-0000207 & BER DE-SC0018269).