Generally, tree species load photoassimilates passively into the phloem, while herbaceous species load actively. These phloem loading strategies have implications for phloem sugar concentration and growth potential. Whereas, in previous research, phloem loading identification was performed with ^{14}C-autoradiography, we suggest ^{11}C-autoradiography, because of its compatibility with plant-PET (positron emission tomography) scans. Because ^{11}C-autoradiography has been hardly used in plant sciences so far, it was tested in contrasting plant species: one temperate tree species, *Populus tremula* L., three tropical tree species, *Erythrophleum suaveolens* (Guill. & Perr.) Brenan, *E. ivorense* A. Chev., and *Maesopsis eminii* Engl., and two herbaceous crop species *Solanum lycopersicum* L. and *S. tuberosum* L. Our results confirmed that *P. tremula* is a passive loader, and *Solanum* spp. are active loaders. *Erythrophleum* spp. and young leaves of *M. eminii* showed the expected passive loading strategy, but the mature leaves of *M. eminii* showed an uncommon pattern. Images corrected for leaf tissue thickness supported that mature leaves of *M. eminii* used active phloem loading, which is linked to continuous investment in growth and new leaves, supporting the lower carbon storage levels often observed in tropical tree species. With this study, we demonstrate that ^{11}C-autoradiography is a powerful tool to acquire detailed tracer distribution in leaves to typify phloem loading strategies in plant species.