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The influence of mistletoes on nutrient cycling in an *Acacia*-dominated semi-arid savanna, southwest Zimbabwe

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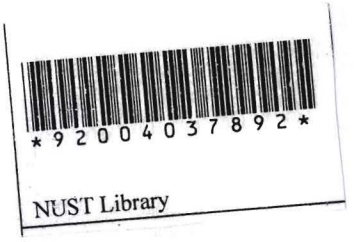

ABSTRACT

Parasitic plants are nutrient parasites and thus are expected to influence nutrient cycling in environments where they occur. However, the role of parasitic plants has largely been ignored in many studies of nutrient cycling. This thesis investigated the effects of hemiparasitic mistletoes, i.e. *Erianthemum ngamicum* (Sprague) Danser (Loranthaceae), *Plicosepalus kalachariensis* (Schinz) Danser (Loranthaceae) and *Viscum verrucosum* Harv. (Viscaceae), on nutrient cycling in an *Acacia* dominated semi-arid savanna woodland in southwest Zimbabwe. Since litterfall is the major pathway for the transfer of carbon and nutrients from plants to the soil, this study assessed the influence of mistletoes on litterfall, nutrient transfer, decomposition and the subsequent effects on soil nutrient concentrations. First, I investigated the patterns of mistletoe infection of *Acacia* trees and tested the relationship between tree size (measured as tree height and trunk diameter) and mistletoe infection intensity. Mistletoe infections were significantly greater in the larger *A. robusta* trees than in *A. gerrardii*, *A. karroo* and *A. nilotica*. Large trees had more mistletoe infections than small trees, and this was true for *P. kalachariensis* and *V. verrucosum* but not for *E. ngamicum*. Similarly, in experimentally disinfected trees, mistletoe reinfections were higher in large than small trees. As a result, there was a positive relationship between mistletoe infection and tree size. However, these relationships were generally weak suggesting that tree size may explain differences in mistletoe infection among host *Acacia* species but other factors may be important in determining mistletoe infection. Given that litterfall and nutrient transfers are driven by the traits of individual plant species, different plant species can be expected to make different contributions to nutrient cycling. Litterfall and nutrient transfers varied among the study species, with results showing that *E. ngamicum* and *P. kalachariensis* and to a lesser extent *V. verrucosum* increase litterfall and nutrient transfers and the effects were greater at high mistletoe density. The increase in nutrient returns was due to both the effect of enriched mistletoe litter and increased volumes of litterfall beneath host trees. Associated with these changes in litterfall was an increase in the abundance and diversity of the litter-layer insects. Additionally, the soil moisture content and bacterial and fungal colony numbers changed with mistletoe infection. These changes were considered to alter litter processing rates, and consequently decomposition and overall nutrient cycling. However, there was little evidence to suggest that they had an effect on litter decomposition. Nevertheless, the high quality mistletoe litters, particularly *V. verrucosum*, decomposed and released nutrients faster than *A. karroo* litter. Nutrient release patterns varied among the mistletoe species, with the loss of N, P and C being higher in *E. ngamicum*, *V. verrucosum* and *P. kalachariensis*, respectively. As a result, mistletoe infection was associated with elevated soil nutrient concentrations, also with higher concentrations at high mistletoe density. Similarly, soil nitrogen (N) transformations and mineral N increased with mistletoe infection but were greatest beneath trees infected by *E. ngamicum* and litter quality, i.e. the condensed tannin, lignin and lignin/N content, was shown to regulate soil N transformations. These findings show that mistletoes significantly enhance nutrient cycling in semi-arid savanna, which supports the notion that mistletoes can substantially influence nutrient availability to other plants. The variation in nutrient cycling attributes among mistletoe species and with mistletoe density along with the patchy distribution of mistletoes was considered to increase the spatial heterogeneity of nutrient availability with important implications for the structure and function of this semi-arid savanna ecosystem. The findings reported herein along with findings in other systems that contain hemiparasites suggest that enhanced nutrient cycling may be a general property of hemiparasites.