Freddie Draper Explorers Club final Report

Determinants of differential herbivory rates between monocotyledon and dicotyledon understorey plants in a Peruvian tropical rain forest.

Background and Methods

Within the understorey of tropical lowland rain forests in South East Asia, Africa, Australia and Central America monocot species have been found to suffer from lower rates of herbivory than neighbouring dicot species (Grubb et al. 2008). It has been suggested that the primary reason for this differentiation is that monocots have tougher leaves than dicots (Dominy et al. 2008), this is somewhat expected as monocots often have a greater proportion of secondary veins which are often well developed and tightly packed in a parallel configuration. Toughness is defined by Lucas et al. (2000) as the ability to “resist crack growth”, and is measured by the energy required to produce a crack of a given area. The importance of leaf toughness to herbivory in tropical rainforests cannot be overstated. Kusar & Coley (2003) showed that the process of leaf toughening is the most important factor in reducing herbivore feeding. Previous to this, Coley (1983) found that leaf toughness was the defensive characteristic that was most negatively correlated with amount of herbivory. In addition, monocot species remain tightly rolled or folded for a greater duration of immaturity than dicot species Grubb & Jackson (2007). Jackson et al. (1999) found that leaves within a temperate forest suffered leaf area loss 2-3 times greater when unrolled and expanding than when rolled or folded and expanding, and it has been suggested this could also be this case in the tropics.

The aims of this study were to see if similar patterns of herbivory, leaf toughness and leaf presentation could be found within monocot and dicot species in an Amazonian lowland rain forest, and explore the relationships between herbivory and leaf traits (including: leaf toughness, leaf presentation, foliar N and P concentrations, and specific leaf area). This
study also took into account phylogenetic non-independence of sampled species which had not been done before in similar studies.

Within the buffer zone of Manu national park, Peru, measurements were made on the leaves of 22 monocot and 16 dicot understorey species at the Manu Learning Centre. Leaf toughness was indirectly measured using a punch test on immature and mature leaves; herbivory was calculated by estimating the percentage of missing lamina area, specific leaf area was calculated in the field and leaves were then brought to the UK for foliar N and P analysis.

Results and Discussion

Monocot species were found to be far tougher than their dicot neighbours (P<0.001), herbivory was also found to be significantly lower on monocot species (P=0.047) in comparison with dicots which agrees with the previous studies of Grubb et al. (2008) and Dominy et al. (2008). However, no significant relationship could be found between leaf toughness and herbivory, when phylogeny was and was not accounted for (table 1).

Table 1 Summary of correlation relationships between the following leaf traits: Leaf lamina area loss (herbivory), leaf punch strength (toughness), specific leaf area (SLA), total leaf nitrogen (total N) and total phosphate (total P) within monocot (n=22) and dicot (n=16) species separately, monocot species are displayed in the lower left half of the table, and dicot in the upper right.
Half of monocots showed a rolling or folding of immature leaves whilst this was extremely uncommon in dicot species (6%), it was also found that species that showed some form of folding or rolling suffered statistically less herbivory than those that showed no form of leaf presentation (P=0.043). This suggests that there is a complex relationship between herbivory and the traits measured, clearly monocots are consumed less but the reasons behind this are less clear. Leaf toughness and presentation are obvious candidates for determining rates of herbivory, but evidence here for the importance of leaf toughness is uncertain. The physical defence features seen within monocot species (of increased toughness and a greater incidence of rolling) in this study may help to account for the high proportion of monocot species relative to dicots found within tropical rainforest understories where herbivory is at its highest.

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References


