What is a grass? Chloroplast DNA reveals that a grass may not be a grass

April 27 2010

A rose by any other name may smell as sweet, but it would no longer be a rose. If a grass is booted out of the grass family, where does it go?

Leah Morris and Dr. Melvin Duvall from Northern Illinois University recently investigated the evolution of grasses, one of the most economic and ecologically important plant families, by sequencing the chloroplast DNA of an early diverging grass genus, *Anomochloa*, and comparing it to the chloroplasts of other grasses. Their results are published in the April issue of the American Journal of Botany. There is only one known species of *Anomochloa*, and it is native to the coastal forests of Brazil in an increasingly fragmented habitat.

By comparing chloroplast genomes of grasses and related families, scientists have observed distinctive evolutionary characters of particular groups of plants, such as the presence or absence of certain genes, introns (non-coding sequences inside genes), and pseudogenes (sequences that resemble closely known genes, but are non-functional). Characters associated specifically with grasses have been based on the chloroplast genome of some of the most commonly studied species, among them the economically important rice, maize, wheat, barley, and bamboo.

However, none of these grasses are part of the small group of species—Anomochlooideae—that is thought to have been among the first to diverge in the evolutionary history of the grass family. The genus *Anomochloa*, one of two genera in Anomochlooideae, has presented

challenges to investigators attempting to understand exactly how it relates to other grasses due to its striking morphogical differences—it has four anthers, where other grasses commonly have three (or occasionally one or six). In addition, the inflorescence of *Anomochloa* resembles the spikelet inflorescence seen in other grasses, but yet is not a true spikelet, making it difficult to compare "apples to apples."

Morris and Duvall's examination of the chloroplast sequence uncovered features the *Anomochloa* chloroplast shares with other grasses, features unique to *Anomochloa*, and features that call into question our definition of grasses or the classification of *Anomochloa* as a grass.

Among the unique features of the *Anomochloa* chloroplast are two that are found in the same operon—a cluster of related genes—called the RNA polymerase operon. An intron is present in the *rpoC1* genes of all monocots other than the grasses previously studied, and the otherwise rare loss of this intron has long been thought to be a defining feature of grasses. However, the intron is present in *Anomochloa*. *Anomochloa* is also unusual in that it contains a uniquely short insert in the *rpoC2* locus. Taxa closely related to grasses do not have this extra sequence at all; other grasses that have been studied have an insert that is nearly twice as long (about 400 nucleotides) as that found in *Anomochloa*.

Also notable is the fact that *Anomochloa* is missing the *rpl23* pseudogene, another diagnostic marker in all other grasses. These features of *Anomochloa* require scientists to either revise their criteria of what characters are essential to a plant's identification as a grass or remove *Anomochloa* from the grass family.

Anomochloa may appear the same today as it did 100 years ago, but our understanding has changed, and *Anomochloa* may have to find a new family.

More information: Morris, L.M. and Melvin R. Duvall (2010). The chloroplast genome of Anomochloa marantoidea (Anomochlooideae; Poaceae) comprises a mixture of grass-like and unique features. American Journal of Botany 97(5): 620-627. DOI:10.3732/ajb.0900226