Notes on Some Grasses XVII. *Metcalfia*, a Primitive Genus of the Tribe Aveneae

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The genus *Metcalfia* includes a single species, *M. mexicana*, which is distributed in the mountains of central and southern Mexico. It was described by Conert¹⁾ in 1960 and based on *Danthonia mexicana* Scribn. The separation of *Metcalfia* from *Danthonia* is clearly supported by differences in various morphological characters, particularly in caryopses and lodicules. Furthermore, *Metcalfia* has been referred to the tribe Aveneae by Conert¹⁾, while *Danthonia* belongs to the tribe Danthonieae. His opinion is based not only on morphological characters but also on leaf structure.

In connection with studies towards a revision of the Aveneae, the present author has examined embryo structure of *Metcalfia*, together with that of a few species of *Danthonia*. Reeder²⁾ and Kinges³⁾ have emphasized the importance of embryo structure in studying relationships among grass genera. The following four characters proved to be of significance: (1) course of the vascular trace, (2) presence or absence of an epiblast, (3) presence or absence of a cleft between the lower part of the scutellum and the coleorhiza, and (4) the form of the embryonic leaf. Reeder²⁾ proposed to express these four characters by certain letter combinations, and his scheme is followed in this paper.

My results are described below, and the affinities and the phylogenetic position of *Metcalfia* are also discussed.

Materials and Methods

A few mature caryopses of the following five species were obtained from the dried specimens preserved in our herbarium: *Metcalfia mexicana* (Scribn.) Conert, *Danthonia chilensis* Desv., *D. compressa* Austin, *D. intermedia* Vasey, and *D. sericea* Nutt. Methods for studying embryo structure were similar to those already described by Reeder²⁾.

Observations

In median sagittal and cross sections of the embryo of *Metcalfia*, the following features have been observed. (1) the vascular trace diverges at about the same point to the scutellum and the embryonic leaf; (2) an epiblast is present; (3) the lower part of the scutellum is fused with the coleorhiza; (4) the embryonic leaf has overlapping margins and five vascular bundles (Fig. 1). These characteristics can be indicated as F+FP following Reeder's scheme²⁾.

The embryos of four species of *Danthonia* examined differ quite significantly. (1)

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the vascular traces of the scutellum and the embryonic leaf are separated by an elongated internode; (2) no epiblast is found; (3) the lower part of the scutellum is separated from the coleorhiza by a cleft; (4) the embryonic leaf has three vascular traces and the margins do not overlap but merely meet (Fig. 2). Embryo structure of *Danthonia* species is thus expressed as P-PF, and this observation accords with Reeder's records²⁾ on the embryos of members of Danthonieae.

Figs. 1 and 2. Median sagittal section (a) and cross section (b) of the embryo. 1, *Metcalfia mexicana*. 2, *Danthonia chilensis*. 1, $\times 35$. 2, $\times 50$.

Discussion

It should first be pointed out that segregation of *Metcalfia* from the Danthonieae is clearly supported by the present observations. Although the tribes Aveneae and Danthonieae doubtlessly belong to different evolutionary lines, they are not clearly distinguished by leaf structure or chromosome features. Aveneae have festucoid features in leaf anatomy and histology. Leaf structure of Danthonieae is very complicated, and further detailed investigations are desirable (cf. Metcalfe⁴⁾). A number of reports have indicated that most species of Danthonieae have panicoid features in leaf epidermis and 'phragmitoid' features (cf. Cáceres⁵⁾) in transection of the leaf. However, de Wet^{6,7)} and Metcalfe⁴⁾ have recorded that a few species of Danthonieae have festucoid leaf structure. The majority of Aveneae are characterized by the large type of chromosomes with $x=7$. Though species of Danthonieae usually show $x=6$, some species have $x=7$.

The differences between Aveneae and Danthonieae in embryo structure, however, are clear-cut. The embryo features of *Metcalfia*, which are quite different from those of Danthonieae, clearly indicate that it is not related to Danthonieae. The F+FP embryo of *Metcalfia* also differs somewhat from the embryos of typical members of

Aveneae, which are expressed as F+FF. This means that in *Metcalfia* the embryonic leaf has many vascular traces and overlapping margins, but in typical members of Aveneae the embryonic leaf has a few bundles and margins which merely meet. Apart from *Metcalfia*, the F+FP embryo has been found in *Brachyelytrum* of Brachyelytreae and in *Oryza* and *Leersia* of Oryzeae²⁾. It is clear, however, that *Metcalfia* is phylogenetically remote from the Oryzeae and Brachyelytreae, considering the great differences in morphological characters and leaf structure. Although *Metcalfia* differs from typical Aveneae in features of the embryonic leaf, it is closer to members of the Aveneae than to any other tribe. *Metcalfia* should therefore be placed in Aveneae, as already indicated by Conert¹⁾.

The embryonic leaf with overlapping margins and many vascular traces seems to represent a more primitive condition than that with a few vascular traces and the margins which merely meet. This supposition may be tenable at least among the embryos of the festucoid group of grasses, which includes the Aveneae; the embryonic leaf with a few vascular traces as found in typical Aveneae seems to be a derived one.

Metcalfia is also distinctive among festucoid genera in having three lodicules, which indicate a primitive state for the genus. The lodicules are elliptic or narrowly elliptic, acute and hyaline. Two of the three lodicules have a fold and a few nerves in the lower part (Fig. 3). These features accord in many respects with those of the so-called festucoid lodicule, but the lodicules of a large majority of the festucoid grasses are two in number and nerveless (cf. Tateoka⁶⁾). It may be reasonable to assume that the nerved lodicules as found in *Metcalfia* are more primitive than the nerveless lodicules of most festucoid genera, as lodicules are considered to represent the perianth, and primitive grasses, such as Bambuseae, Arundineae, etc., have nerved lodicules without exception. *Metcalfia* is a perennial grass without advanced features in spikelet or gross morphology. *Metcalfia* seems to be one of the most primitive ancient festucoid genera, such as might have been produced in the early stages of evolution of the festucoid group.

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Summary

Embryo structure of *Metcalfia* and four species of *Danthonia* was studied. Following Reeder's scheme²⁾, the embryo features of *Metcalfia* can be expressed as F+FP, and those of *Danthonia* as P-PF. These observations indicate that *Metcalfia* is quite distinct from the Danthonieae and should be placed in the Aveneae. The morphological properties of *Metcalfia* suggest that it is probably one of the most primitive festucoid genera.

Fig. 3. Lodicules of *Metcalfia mexicana*. $\times 15$.

References

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摘 要

館岡亜緒：イネ科雑記 XVII. *Metcalfia* について

Metcalfia はメキシコの山地にみられる 1 属 1 種の属である。従来 *Danthonia* に含まれていたものであるが、1960 年に Conert によって独立の属とされ、さらに *Danthonieae* ではなくカラスムギ族に位置づけられた。その外部形態に原始的な特徴がみられ、もしこれがカラスムギ族の 1 員であるとする、カラスムギ族を含めたいわゆる *festucoid group* の進化史の研究にとって重要な位置をしめる。これまで *Metcalfia* がカラスムギ族に含まれるか否かについて十分に検討されていなかったもので、ここにその胚の構造を調査し、外部形態を再検討した。また *Danthonia* の 4 種の胚の構造を比較のために調査した。その結果、*Metcalfia* はカラスムギ族に属するものであること、および、胚の構造にも *Metcalfia* の原始性があらわれていること、がたしかめられた。(国立科学博物館)