

CHAPTER VI

GENERAL CONCLUSION

A preliminary taxonomic account of both subtribes is presented. Thirteen genera, 49 species and 2 infraspecific taxa are enumerated and described. Among these, *Ischaemum* (13 species and 1 infraspecific taxa) and *Eremochloa* (11 species) are the two largest genera. The members of both subtribes generally are found along roadsides, in paddy fields, swampy areas, near streams, savannas, deciduous forest, beach forest, dipterocarp forest, secondary forest, evergreen forest and pine forest from sea level to 2,350 m. Of these, *Apluda mutica*, *Ischaemum indicum*, *I. rugosum*, *Mnesithea glandulosa* and *Rottboellia cochinchinensis* are common as they are found in all floristic regions in Thailand. However, 12 species are endemic and rather have a restricted distribution.

One new combination of the genus *Andropogon* L.: *I. tenuifolium* (A. Camus) P. Traiperm & T. Boonkerd (*ined.*) is made. Two taxa, *Ischaemum hubbardii* and *Mnesithea striata* var. *pubescens* are newly recorded for the country. A variety i.e. *Ischaemum barbatum* var. *glaberrimum* was treated as synonym of *I. barbatum*. Five taxa of *Ischaemum*, i.e. *I. aristatum* subsp. *imberbe* var. *imbricatum*, *I. aristatum* var. *arfakense*, *I. lacei*, *I. magnum* and *I. macrurum* are lectotypified.

It is expected that six species in the genera *Ischaemum*, *Eremochloa* and *Mnesithea* are new species. (1) *Ischaemum* sp.1 resembles *I. barbatum* in the lower glume of the sessile spikelet. However, the latter is easily distinguished by having more than one coarse-ridge across the back of the lower glume of the sessile spikelet and by the two or more nodules along the margins. *Ischaemum* sp. 1 has a leaf-blade pubescent on both surfaces, and margin recurved or folded; while *I. barbatum* has a flat leaf-blade, which is glabrous to pilose on both surfaces. It was found at Khao Soi Dao, Chanthaburi and Khao Panom Bencha, Krabi. The molecular study showed that these two species are in the same clade with a moderate bootstrap support of 78%, therefore *Ischaemum* sp.1 can be proposed as a new species or a new variety of *I. barbatum*. (2) *Ischaemum* sp.2 is similar to *I. lacei*, but can be distinguished by its glabrous leaf blade, whereas the leaf-blade of *I. lacei* is pilose with tubercle-based hairs on both surfaces. It was only found at Phu Khao Yah National Park, Ranong. In

the molecular results, *I. sp.2* is also in the same clade with *I. indicum* with weakly bootstrap support of 74%. Hence, *Ischaemum sp.2* can be proposed as a new species or a new variety of *I. indicum*. (3) *Eremochloa sp.1* is very closely related to *E. maxwellii* but differs considerably in having an obovate and long cordate pedicel as compare with the obliquely-lanceolate pedicel in *E. maxwellii*. This species is found in north-eastern Thailand. The results of the molecular study confirmed that *Eremochloa sp.1* can be purposed as a new species, not a variety of *E. maxwellii*. (4) *Eremochloa sp.2* resembles *E. muricata*, but can be distinguished from the latter by its subulate pedicel, in contrast to the obliquely obovoid pedicel in *E. muricata*. This species is only found at Phu Kradueng, Loei. (5) *Mnesithea thailandica* is distinguished by having appressed hairs on the inflorescence. It is similar to *M. geminata*, but differs in having a small, erect and slender culm, ca. 26 cm tall. The species has pubescent hairs on the back of the triangular lower glume, rachis nodes, pedicels and rachis internode, while *M. geminata* is lanceolate and hirsute on the lower glume below and glabrous on rachis nodes, pedicels and rachis internode. (6) *Mnesithea sp.1* is closely related to *M. striata*. *Mnesithea sp.1* is characterized by the lower glume of the sessile spikelet oblong, indurate, 5–5.5 by 1.2–1.5 mm, an apex with unequal wings, 7–8 longitudinal rows of small pits between the nerves of the back of the leaf blade, and margins at base puberulous. In contrast, *M. striata* has indurate ovate lower glume at the sessile spikelet, 4.5–5 by ca. 1.5 mm, the apex has 2 apical wings, and having continuous ridge along the length and interrupted by tubercles or tubercle-based hairs on the back or glabrous. The molecular analysis supported that *Mnesithea sp.1* should be proposed as a new species in the genus *Mnesithea*.

In comparison with a previous study of grass group in Thailand (Nanakorn & Norsaengsri, 2001), there are eight additional taxa reported from this study, namely *Ischaemum hubbardii*, *I. sp.1*, *I. sp.2*, *E. sp.1*, *E. sp.2*, *M. striata* var. *pubescens*, *M. thailandica* and *M. sp.1*. Seven misidentified taxa are re-determined and listed in this study, viz. *Ischaemum mangaluricum* (*I. barbatum*), *Sehima sulcatum* (*Andropogon sp.*), *Eremochloa zeylanica* (*E. bimaculata*), *Mnesithea geminata* (*M. mollicoma*), *Ophiuros bombaiensis* (*M. laevis*), *O. megaphyllus* (*O. exaltatus*) and *Thaumastochloa cochinchinensis* (*M. laevis*).

The epidermal peels and transverse sections of leaf-blades and culms have also been investigated in 25 species of the 12 genera from the two subtribes. It was

shown that a number of anatomical characters are taxonomically useful for separating the related genera in the subtribes Ischaeminae and Rottboelliinae of Thai grass: leaf blade outline, ribs and furrows on both surfaces, bulliform cells, midrib and keel, number of vascular bundles in the keel, shape of sclerenchyma at margins, intercostal long cells, papillae, prickles, macro-hairs, silica bodies, culm outline and central cavity in ground tissue of culm. However, this anatomical study does not support the previous segregation of the two subtribes Ischaeminae and Rottboelliinae. It also does not support the morphological classification system proposed by Clayton & Renvoize (1986).

The phylogenetic analysis of 44 samples from 38 taxa was conducted on non-coding chloroplast DNA *trnL* intron and *trnL*-F spacer and nuclear ribosomal internal transcribed spacer (ITS) sequence data. The Maximum Parsimony analysis was conducted using PAUP* 4.0b10. Both data sets were analyzed separately before being combined into a single data set. The analysis indicated that a combined ITS and *trnL*-F analysis strengthens the signal and also points to a non-monophyletic origin of both subtribes which correspond with previous studies (Kellogg & Watson, 1993). However, these two groups of subtribes do not support the subtribal designations by Clayton & Renvoize (1986). Two main lineages can be identified as identical to the analysis of *trnL*-F data, while the analysis of ITS provides evidence for phylogenetic examination of closely related taxa or among the species. The *trnL*-F and combined analyses suggest that *Hemarthria*, *Hackelochloa* and *Eremochloa* are monophyletic. Resolution within the *Ischaemum* and *Mnesithea* clades is rather weak to high bootstrap support showing that both genera are not monophyletic.

The taxonomic study suggested that *I. tenuifolium* belongs to the genus *Andropogon* instead of *Ischaemum*. The species has 3–7 digitate racemes, 6–12 cm long, borne upon sub-equal flattened raceme-bases, and the lower glume of sessile spikelet is concave, which are all diagnostic features of *Andropogon* (Clayton & Renvoize, 1986). This new combination is in agreement with the anatomical description of the genus, while the species fails to conform completely to the general pattern in the genus *Ischaemum*. In addition to this, the molecular analysis exhibits a poor bootstrap supported (<50%) topology of *I. tenuifolium* excluded from the genus *Ischaemum*.

The genus *Coelorachis* has been reduced as a synonym of *Mnesithea* by Veldkamp et al., (1986); this was confirmed by the present taxonomic study. In

several species of *Coelorachis* the lower part of pedicel is completely fused to the rachis node. The pedicelled spikelet varies from well developed to minute vestige, and its absence in traditional *Mnesithea* is just the final step. On the other hand, the analysis of the combined molecular data set demonstrates a weakly bootstrap supported clade to separate *M. laevis* from other *Mnesithea* species, and also the anatomical study emphasizes that there are some heterogeneity of these species within the genus. The analysis of the combined data set suggests the segregation of the genus *Mnesithea*, which corresponds to the classification system proposed by Clayton & Renvoize (1986).