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We need to talk about *Fargesia*: new combinations and a new genus in the temperate Sino-Himalayan bamboos (Poaceae: Bambusoideae)

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Abstract. Morphology, phylogenetics and classification of temperate pachymorph-rhizomed Sino-Himalayan bamboos in *Yushania* and the current polyphyletic application of *Fargesia* are discussed. In the light of well-resolved topologies from ddRAD sequencing analyses, different possible approaches to the recognition and circumscription of genera are considered. The merits and disadvantages of applying strict rules of molecular phylogenetics or a more phenetic system to binomial nomenclature are discussed, and a compromise evolutionary taxonomy approach is recommended for species in western cultivation. This allows *Fargesia* to be applied to a small group of species with racemes, *Yushania* to species with long rhizomes, and *Borinda* to be applied to species with ridged culms. A new genus is also described for a separate monophyletic clade, and new combinations are made in the apparently paraphyletic genus *Borinda.*

Keywords: China, Himalayas, morphology, phylogeny, ddRAD, *Borinda*, *Yushania*, *Tongpeia*

INTRODUCTION

The temperate bamboos of the Sino-Himalayan mountain chains have always been problematic for taxonomists. The morphology of bamboos and the terminology to describe them were neglected until quite recently (McClure 1966, McClure 1973, Stapleton 1997), making descriptions difficult to interpret or compare. Sparse, incomplete collections from remote locations, and competing opinions on character weighting and generic breadth led to difficulties in agreeing any phenetic treatment. Early molecular analyses failed to clarify relationships in any detail. Hybridisation and introgression have complicated relationships, and the long generation times caused by infrequent flowering have resulted in incomplete lineage sorting, reflected in poor resolution as well as conflicting topologies in molecular studies. Current classification in this temperate group (Bamboo Phylogeny Group 2012, Kellogg 2015, Vorontsova et al. 2016) has continued to follow an outdated and unsatisfactory phenetic system, which fails to make use of either current morphological knowledge or molecular insights into phylogeny. This unsatisfactory situation needs to be re-examined, to assist documentation, conservation, utilisation and horticultural cultivation of these highly desirable ornamental bamboos.

PHENETIC TREATMENTS

The two largest temperate genera, *Fargesia* Franchet and *Yushania* Keng are at the centre of the problem. Extensive fieldwork, description of scores of new species within both genera, and transferral of older species into them from *Arundinaria* all increased substantially from the 1970s onwards. Many have been introduced into cultivation, where they have received greater study, and their flowers are eventually becoming known without further fieldwork.

Two characters, inflorescence compression and rhizome neck length provide the most obvious morphological variation in this group of about 150 species, but they are not directly correlated. *Yushania* species have open panicles, and long rhizome necks, which allow them to spread widely. Species of *Fargesia,* as currently interpreted in a broad sense, have short rhizomes, and either compressed and spathed racemes, racemose panicles or open panicles. Priority can be given to either the inflorescence or the rhizome, so that interpretation of the boundaries between the two genera have varied. Because of infrequent flowering in bamboos however, most species have been described without any knowledge of the inflorescence. They were often simply placed in *Fargesia* if they had short rhizomes and grew exclusively in clumps, or *Yushania* if they had longer rhizomes and could spread (e.g. Yi 1988). It was felt by others however, that floral characters were more important than vegetative organs such as rhizomes (e.g. Chao & Renvoize 1989). Thus the application of the names *Fargesia* and *Yushania* became controversial both in China and in the West, with two conflicting approaches followed by different institutions, as reviewed by Li (1997) and Stapleton (1998).

In a third phenetic system applied to Himalayan bamboos (Stapleton 1994), a new genus *Borinda* Stapleton had been described for species with short rhizome necks and panicles, while *Fargesia* was reserved for those core species having short rhizomes and compressed unilateral spathed racemes, which are not found at all in the

Himalayas, and *Yushania* continued to be applied only to those species with long rhizome necks, and panicles. Early molecular phylogenies did not provide sufficient resolution to give support to any of these 3 approaches.

While the Himalayan species were all known in sufficient detail to place them in the most appropriate genus, either *Fargesia*, *Borinda*, or *Yushania*, in China the situation was different. A very large number of new species had been described in *Fargesia* in the previous 2 decades without full knowledge of their inflorescence structure, and often with less than complete knowledge of vegetative components. Thus *Fargesia* in China was more confusing

To complicate this further, Chinese knowledge of Himalayan bamboo genera was limited, and all clump-forming species from Tibetan Himalayan valleys were included in *Fargesia*. Several of these were clearly better placed in other genera such as *Thamnocalamus* Munro, *Himalayacalamus* Keng f. or *Drepanostachyum* Keng f., and were duly transferred. *Thamnocalamus* is readily distinguished by its complete vegetative branch sheathing with no reduction (Stapleton 1994a). *Fargesia*, *Borinda* and *Yushania* have moderate reduction of sheathing. *Himalayacalamus* and *Drepanostachyum* have more extensive reduction in sheathing and greater proliferation of higher order branch axes, leading to broader, shorter buds with more branch initials evident (Stapleton 1991).

However, this still left a very large number of Chinese species of uncertain affinity in *Fargesia*. Some were known to have similarities to the Himalayan *Borinda* species, but many were incompletely documented. In addition, there were also several species in China that were difficult to place in any of these 6 genera, even when morphological characters were well known. These species have inflorescences that are neither clearly racemose nor paniculate, or broader buds, or asymmetrical branching, or lightly sulcate culms. Some also have longer rhizome necks that are intermediate in length between those of *Yushania* and other genera.

Faced with these seemingly intractable problems, when pursuing an updated classification of Chinese temperate bamboos, Li (1997) decided to recognise *Fargesia* as a large polymorphic genus. It was felt that differences in rhizome length would not be consistent enough to distinguish *Borinda* from *Yushania*. There also seemed to be insufficient clear distinction between inflorescence types to separate *Borinda* from *Fargesia*, although that was partly because *Fargesia* was still being included in *Thamnocalamus* (Chao & Renvoize 1989, Li 1997). The later removal of *Fargesia* from *Thamnocalamus* (Li et al. 2006) clarified the distinction between the inflorescences of *Fargesia* and *Borinda*, as *Thamnocalamus* has partially compressed and lightly spathed racemose panicles, intermediate in compression between those of *Fargesia* and *Borinda*.

In western cultivation a few species, mainly those from the Tibetan Himalayan valleys and Yunnan, became better known and were transferred from *Fargesia* into *Borinda* (Stapleton 1998) on the basis of floral or vegetative characters that could distinguish them from *Yushania* and *Fargesia*. A better understanding of minor vegetative characters correlated with inflorescence variation allowed prediction of generic placement in the absence of flowers for some Chinese species, including fine ridging of the culm internode and softer leaf texture for *Borinda* species, although descriptions sometimes overlooked such details. However, this still left the bulk of *Fargesia* species from Yunnan and Sichuan, with possibly up to 50 or more candidates for transferral out of *Fargesia*. For the Flora of China *Fargesia* account a compromise was reached (Li, Guo & Stapleton 2006), in which all *Borinda* species were kept under *Fargesia s.l.*, which avoided an unsatisfactory division of *Borinda* species between 2 genera simply according to how well they were known. This unfortunately was dutifully followed in later global accounts, repeating the broad and polyphyletic interpretation of *Fargesia* (Bamboo Phylogeny Group 2012, Kellogg 2015, Vorontsova et al. 2016). *Borinda* was only recognised in a few taxonomic treatments (Wang 1997, Ohrnberger 1999, Stapleton 2000), although it is used in western horticulture and Himalayan forestry.

It should be noted that nearly all phenetic systems followed have maintained a clear distinction between different rhizome forms. Not only is this character the most obvious feature for bamboo identification, in horticulture and forestry spreading and potentially invasive rhizomes are a critical characteristic. Whether bamboos grow in clumps or spread invasively is important for ecology, soil conservation, forest management and horticultural species selection. Spreading bamboos can dominate ground flora to prevent tree regeneration, invade cultivated land, and lead to litigation or even prosecution. The rhizome characters that control spreading are thus of great informative and predictive value, and are critical for identification and utilisation.

MOLECULAR PHYLOGENY

Molecular investigations that sequenced chloroplast or nuclear DNA gene regions did not clarify relationships within the *Fargesia-Yushania* group conclusively. Zhou et al. (2019) thoroughly reviewed earlier molecular results for *Fargesia* and allied genera. They concluded that the existing evidence from molecular phylogenetic studies suggested that neither *Fargesia* nor *Yushania* could be resolved in either of the conflicting chloroplast and nuclear topologies

inferred, and that all species should simply be combined into one very large polymorphic genus, even though it still lacked support as a monophyletic group.

However, more recently, double digest restriction site associated DNA sequencing (ddRAD) has been applied, and this is considered to be a powerful new tool for phylogenetic reconstruction in difficult unresolved radiated polyploid groups such as the woody bamboos (Guo et al. 2020). Ye et al. (2019) reported the most comprehensive ddRAD analysis for this particular group. They confirmed and expanded upon earlier preliminary RAD findings (Wang et al. 2017), including a greatly increased number of species, representing 79% of known species in the group, from NW India to Taiwan.

In the ML topology recovered by Ye et al. (2019), all of the 70 or more species that were described in *Yushania* on the basis of their long rhizome necks, were resolved in a well-supported monophyletic clade, distinct from all species with different rhizome forms, either short-necked pachymorph, or leptomorph (Figure 1). This is a remarkable finding, demonstrating the phylogenetic importance of rhizome neck length in these woody

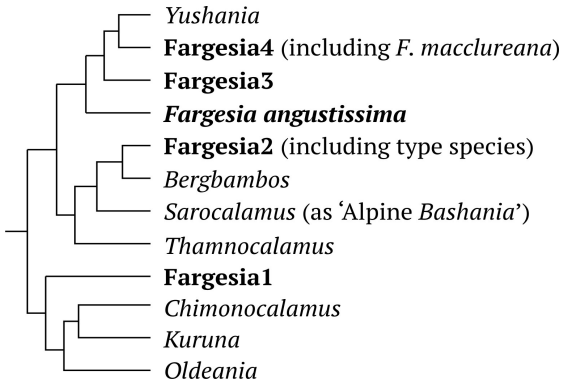

Figure 1. Major clades from maximum likelihood topology resolved from ddRAD by Ye et al. (2019), all branches with > 95% bootstrap support, (outgroup leptomorph-rhizomed *Phyllostachys* + *Ferrocalamus* + *Indosasa*). Further well-supported minor clades were also resolved.

bamboos, in addition to its phenetic value and great importance for identification and use. The lack of support for *Yushania* in earlier molecular analyses had suggested this character might be homoplasious within *Yushania* and *Borinda*, or that its assessment by different observers might be subjective. This result immediately made earlier molecular results, and such suspicions redundant. When this topology is recognized, it also removes the remaining constraint to recognition of *Borinda* applied by Li (1997). Guo et al. (2020) concluded that the rhizome states were showing clear phylogenetic signal, and described the long rhizome neck as a synapomorphic character that has evolved only twice in this group, in *Yushania* in Asia and in *Oldeania* Stapleton in Africa.

In addition to the resolution of a monophyletic *Yushania*, the species that had previously been placed in *Fargesia s.l.* regardless of inflorescence type (Li et al. 2006, Vorontsova et al. 2016), were resolved in several well supported clades, located in 3 well separated groups, clearly demonstrating the polyphyly of *Fargesia s.l.* One of these groups, 'Fargesia2', contained 11 species, among them the type species of *Fargesia*, *F. spathacea.* It included all those with compressed unilateral racemes and persistent spathes, all from Central China, mainly in the Qinling and Daba Shan ranges. 'Fargesia2' was monophyletic and very well separated from the rest of the *Fargesia* species, sister to the S. African genus *Bergbambos* Stapleton, and together they were sister to the leptomorph-rhizomed genus *Sarocalamus* Stapleton (referred to as 'alpine *Bashania*'). Together these 3 clades were sister to *Thamnocalamus*.

The separate resolution of this core group of *Fargesia* species including the type species, as 'Fargesia2', confirms what had been expected from phenetic treatments (Stapleton 1994a, 1998), and suggested, but with limited support in many earlier molecular studies (Guo et al. 2001, Guo et al. 2002, Ní Chonghaile 2002, Guo & Li 2004, Hodkinson et al. 2010, Triplett & Clark 2010, Zhang et al. 2012, Zhang et al. 2019). *Fargesia s.s.* is a relatively small genus with tightly compressed racemes and restricted distribution, as now demonstrated with good support by Wang et al. (2017) from RAD, and Zhou et al (2019) from complete plastome sequences. *Fargesia* is not found in the Himalayas or most of the Hengduan Mts. It would appear that the majority of species described in *Fargesia*, mostly from Yunnan, Sichuan and Tibet, cannot remain in that genus following any modern classification.

A second group, of 14 species, called 'Fargesia1' was monophyletic and sister to the thorn-bearing *Chimonocalamus* Hsueh & T.P. Yi and African genera. They have varied characteristics, and further study is required to look for and test unique combination of shared characters for 'Fargesia1' or its subclades. Detailed knowledge of the characteristics of some species is lacking, but several species known in cultivation share possession of broader buds than those of *Fargesia*, *Yushania* or *Borinda*, a character which has led to one species at least being transferred into *Drepanostachyum–D. fractiflexum* (T.P. Yi) D.Z. Li. Some also lack the elevated podium commonly seen between the node and the branches of those 3 genera. They also lack the finely ridged culm internodes common in *Borinda*. The well-supported separation of these into a monophyletic group that is clearly not part of either *Fargesia* or *Borinda* (nor *Drepanostachyum* according to earlier results such as those of Guo & Li 2004, Wang et al. 2017) simplifies the characterisation and delineation of *Fargesia s.s.* and

Borinda. However, in the absence of any nomenclatural treatment of this group, recognition of *Borinda*, along with *Fargesia s.s.*, is very difficult. Other species such as *Fargesia membranacea* (*Drepanostachyum membranaceum* (T.P. Yi) D.Z. Li) and further apparently undescribed species in cultivation may also belong in this group.

The remaining 40 *Fargesia* species, comprising the majority of the species described in *Fargesia*, formed a third group, which were resolved into 3 clades by Ye et al. (2019): *F. angustissima* (*Borinda angustissima*), 'Fargesia3' (9 species) and 'Fargesia4' (30 species), with more than 10 well-supported internal subclades. These species combine short rhizomes with paniculate inflorescences, narrow buds and a swelling or promontory between branching and node, and nearly all have a further distinctive characteristic, finely ridged culm internodes. Together the species in this group correspond to the species and characters that are found in a phenetically delineated *Borinda*, including the type species of *Borinda*, *F. macclureana* (Bor). Stapleton. In Ye et al. (2019), while *Yushania* was resolved as monophyletic, this group of species was paraphyletic, as a grade of 3 clades. However, the topology of this group requires further clarification and different future analyses might produce different relationships.

CLASSIFICATION

The phylogenetic topologies, the morphological characteristics of the clades, and those associated with the generic names that have been applied to the species and groups within the topologies need to be carefully considered together before any satisfactory classification or nomenclatural treatment of these taxa can be undertaken.

The long-necked pachymorph rhizomes in *Yushania* are a synapomorphic character that has been considered important enough for the description of more than 100 basionyms in that genus, in clear and near-universal distinction from other genera used for clump-forming species with shorter rhizomes. Moreover, *Yushania* is now clearly known to be monophyletic when circumscribed on this important character. However, *Yushania* is part of a larger monophyletic group, and its recognition renders other groups paraphyletic. *Fargesia s.l.* is a polyphyletic assemblage of monophyletic and paraphyletic clades and grades of uncertain real topology and mixed rank. *Borinda*, as currently circumscribed has a paraphyletic component, but is also polyphyletic, having some species in 'Fargesia1'.

There are several potential approaches to the classification and application of generic nomenclature to this group, listed in Table 1. The first is to continue to follow the current phenetic approach (Li 1997, Li et al. 2006, Ye et al. 2020), with the continued recognition of a very polyphyletic *Fargesia s.l.*, defined essentially on the absence of *Yushania*'s long rhizome necks, but this becomes increasingly difficult to accept in any modern taxonomic treatment. Approach 2 could be the merger of many recognized genera, including *Fargesia*, *Yushania*, but now necessarily also the genera *Bergbambos*, *Sarocalamus* and *Thamnocalamus*, into a very large and extremely heterogeneous genus with no informative characters, which

	1 (Flora of China)	**2**	**3/4**	**5**	**6**
	Yushania	Fargesia	Yushania	***Yushania***	***Yushania***
	Fargesia	Fargesia	Yushania	***Borinda***	Borinda
	Fargesia	Fargesia	Yushania	***Borinda***	gen. nov.
	Fargesia	Fargesia	Yushania	***Borinda***	gen. nov.
	Fargesia	Fargesia	***Fargesia***	***Fargesia***	***Fargesia***
	Bergbambos	Fargesia	***Bergbambos***	***Bergbambos***	***Bergbambos***
	Sarocalamus	Fargesia	***Sarocalamus***	***Sarocalamus***	***Sarocalamus***
	Thamnocalamus	Fargesia	***Thamnocalamus***	***Thamnocalamus***	***Thamnocalamus***
	Fargesia	***gen. nov.***	***gen. nov.***	***gen. nov.***	***gen. nov.***
	Chimonocalamus	***Chimonocalamus***	***Chimonocalamus***	***Chimonocalamus***	***Chimonocalamus***
	Kuruna	***Kuruna***	***Kuruna***	***Kuruna***	***Kuruna***
	Oldeania	***Oldeania***	***Oldeania***	***Oldeania***	***Oldeania***

Table 1. Possible approaches to classification of *Fargesia* and generic recognition following phylogeny of Ye et al. (2019).
Black: monophyletic; Red: polyphyletic; Orange: paraphyletic
Italic: informative; Regular: uninformative - conflicting with known morphological characters.

would be very difficult to define morphologically. This was essentially proposed by Zhou et al. (2019), but based on plastome sequence phylogeny with a limited range of species. It can now presumably be discounted altogether.

Three other approaches, nos. 3, 4 & 6, follow strict cladistic phylogenetic principles, but they struggle to work well when expressed through a simple binomial taxonomy with nomenclature based on descriptions of characters and essentially only 2 levels. Either good synapomorphic characters are lost from the genera recognised, or smaller genera are based on clades lacking good synapomorphic characters, or any unifying characters at all.

Approach 3 would be the transfer of many *Fargesia* species (*F. angustissima*, 'Fargesia3' and 'Fargesia4') into *Yushania*, which would then include *Borinda*. This overlooks both synapomorphic and symplesiomorphic characters of informative and predictive value in this group, which has notoriously few such characters. Approach 3 would be likely to require subgeneric taxa for 3 paraphyletic clades such as *Borinda*, which we could call Approach 4, but morphological characters to describe these clades are currently lacking. If they were given subgeneric rank, while that may reflect evolution slightly better, it still only results in a crude approximation to the complex phylogeny inferred from the topology, which has many levels of subclade. In a binomial system of nomenclature, it becomes the same as Approach 3 at the generic level. It conflicts with the objective of maintaining a predictive Linnaean binomial system as the generic names themselves lose meaning. If some form of trinomial nomenclature were to be agreed upon instead of the Linnaean binomial system, and users could be persuaded to follow it, then Approach 4 might be acceptable, but given the difficulties users have with long binomial names, often in combination with a cultivar name as well, the chances of this happening do not seem very high. Forcing a complex multilayered topology onto a naming system for popular consumption that only has 2 ranks, while applying the same rules of multilayered clade recognition, may not be wise.

Approach 6 would be the recognition of 3 separate monophyletic genera for *F. angustissima*, 'Fargesia3' and 'Fargesia4'. 'Fargesia4' would be *Borinda*, but there does not seem to be any morphological justification for the establishment of new genera for either *F. angustissima* or 'Fargesia3'. *F. angustissima* has been transferred into *Borinda* on the basis of its similarity to the species of 'Fargesia4', and no generic level distinction between it and the other species is currently evident.

Approach 5, favoured here, is the recognition of a paraphyletic *Borinda* for *F. angustissima*, 'Fargesia3' and 'Fargesia4'. The importance of the long rhizome necks in *Yushania* cannot be overstated, but the existence of a monotypic genus with this synapomorphic character renders this grade of 3 clades paraphyletic according to the topology resolved in the ddRAD study (Ye et al. 2019). The pattern of evolution implied by the topology of *Yushania* + (*F. angustissima,* 'Fargesia3' and 'Fargesia4'), in which a member of a larger monophyletic clade evolves into a separate monophyletic clade, the recognition of which renders the remainder paraphyletic, is widely seen in nature, and causes a conflict between the twin objectives of reflecting both relatedness and similarity. Which should take priority in a classification, understanding or application, pure science or applied science? There appear to be insufficient characters in the 3 clades for their description and naming as separate genera. Most would agree that recognition of such paraphyletic taxa, but not polphyletic ones, is a clear improvement on artificial phenetic taxonomy. The relative importance of utility in classifications versus adherence to rigorous cladistic phylogenetic principles will probably be fiercely debated for some time. Pure cladistic phylogenetics may not really be attainable anyway, once forced onto a binomial system of nomenclature, not to mention the technically problematic but widespread recognition of monotypic genera as monophyletic. This fifth approach balances various objectives of inferred monophyly, diagnosibility, predictive value, binomial usability, general utility, and also limits generic size to manageable levels. Though possibly more subjective, 'evolutionary taxonomy' or 'phyletics', if that is what this approach should be called, is of considerable value for understanding, documenting and conserving biodiversity in taxonomically challenging groups such as the bamboos. In the case of *Yushania* and *Fargesia* the widespread recognition of the manifestation and importance of the longer rhizome necks in *Yushania*, and the large size of both genera adds greater weight to the argument for recognition of a paraphyletic *Borinda*.

There clearly are different attitudes and approaches to generic delimitation (Humphreys & Linder 2009, Schmidt-Lebuhn 2012, Holynski 2016), and no real reason why different classification systems should not be proposed or followed simultaneously in different disciplines. Attempts to establish the infallibility of any approach can be disingenuous, and attempts by institutions to enforce their own favoured approach on the basis of 'accepted status' are unhelpful and unscientific. Phylogenetic systematics may be best represented by a cladogram, with limitless subclades, updated as and when data improves or techniques develop. It should not be overlooked that the latest phylogeny of Ye et al. (2019) conflicts dramatically with the best plastid and nuclear phylogenies obtained (Zhang et al. 2019, Zhou et al. 2019, Guo et al 2020), which themselves have been contradictory (Zhang et al. 2012). Plant identification, conservation and use may be best served by names based on an informative and predictive 'evolutionary taxonomy' approach to the

delimitation of genera, based upon descriptions while avoiding homoplasy demonstrated by molecular analysis, expressed in a simple binomial nomenclature. Both systems can co-exist without one detracting from the other, similarity complementing relatedness or *vice versa*.

NOMENCLATURE

The authors of the ddRAD molecular results (Ye et al. 2019) refrained from drawing any taxonomic conclusions, presenting the results in a purely biogeographical context. However, they later described a new species for *F.* sp.2 from their 'Fargesia4' clade as *Fargesia viridis* D.Z. Li & X.Y. Ye (Ye et al. 2020), explicitly circumscribing *Fargesia* in a very broad polyphyletic sense, following phenetic infrageneric taxa of Yi (1988). They even included *F.* sect. *Ampullares* T.P. Yi, which contains several species justifiably transferred from *Fargesia* to *Drepanostachyum* and *Himalayacalamus*, in addition to the 4 clades they had themselves previously resolved in an already very polyphyletic *Fargesia*. Similarly in another follow-up paper (Ye et al. 2021) they described their previous *Yushania* sp. 3 & *Yushania* sp. 4, explicitly circumscribing *Yushania* as a genus with long-necked rhizomes. In the light of this it seems very unlikely that they would recognize the genus *Borinda* in China, or change their circumscription of *Fargesia* or *Yushania*. It also seems problematic for any institution-based taxonomist from any country to support recognition of paraphyletic genera at the current time.

It seems unfortunate if, thanks to the very high standard of recent molecular investigations, our knowledge of phylogeny is greatly improved but this is not translated into usable improvements in classification and nomenclature. Therefore combinations are made here in *Borinda* for those who wish to follow an evolutionary taxonomy approach and recognise the apparently paraphyletic genus *Borinda*, rather than following an outdated phenetic approach with a polyphyletic *Fargesia*, or follow only monophyletic taxa (ddRAD topology), losing important informative characters at the generic level.

NEW COMBINATIONS IN *BORINDA* FOR CLADES 'FARGESIA4' AND 'FARGESIA3'

Ye et al. (2019) resolved 40 species in the 'Fargesia3' + 'Fargesia4' + *F. angustissima* clades, rather than the distantly related clade that included the type species of *Fargesia*. Zhang et al. (2019) also resolved several of those species in a mixed *Borinda*/*Yushania* clade from a nuclear ITS analysis, which gives further support to their placement, and had also included *Fargesia emaculata* T.P. Yi and *F. similaris* Hsueh f. & T.P. Yi, which resolved in the same group. There are thus a total of 30 names in *Fargesia* that were not already transferred to *Borinda*, which were resolved into the *Borinda* grouping, in Zhang et al. (2019) from ITS analysis, or Ye et al. (2019) from ddRAD, or both. New combinations in *Borinda* are given for most of these here. The descriptions of these species and illustrations where available, and known characteristics of those in cultivation, support their inclusion, except for *Fargesia yajiangensis*. That species was described as having level culm internodes (*laevigatus*). It was diagnosed as related to *Fargesia nitida* (Mitford ex Bean) Keng f. ex T.P. Yi, and was itself the species that *Fargesia damuniu* T.P. Yi & J.Y. Shi (syn. of *Thamnocalamus nepalensis* Stapleton) was contrasted with in its description (Yi et al. 2007). As both *Fargesia nitida* and *Thamnocalamus nepalensis* have very smooth culms this species name is consequently not transferred until the sample used by Ye et al. (2019) has been checked, as it would be the only smooth-culmed species in the genus, and may possibly have been misidentified.

All the species transferred here have short rhizomes, narrow lower mid-culm buds, and branching inserted above some form of promontory distancing branches from the node, and finely ridged culms described variously as porcate, lineate, striate, or costulate, etc. (Figure 2B). Those with known flowers lack the tight unilateral racemes enclosed in persistent spathes seen in 'Fargesia2'. Their inflorescences are ebracteate and paniculate. Directly comparable, well-illustrated examples of the inflorescences of Fargesia2', most members of 'Fargesia1', *Borinda* and *Drepanostachyum* can be seen for *Fargesia qinlingensis* T.P. Yi, *F. canaliculata* T.P. Yi, *F. subflexuosa* T.P. Yi and *F. semiorbiculata* T.P. Yi respectively, in the inflorescence review of Zhang & Ren (2016). Rhizome forms for the clades were illustrated in Guo et al. (2020).

There are several other recently described *Fargesia* species that have been comprehensively described or illustrated with characters that are strongly suggestive of *Borinda*, but they have not yet been included in molecular studies. Examples are *F. microauriculata* M.S. Sun, D.Z. Li & H.Q. Yang, which shows porcate culms, tall buds and pedicellate spikelets, *F. huizensis* M.S. Sun, D.Z. Li & H.Q. Yang, and *F. purpurea* D.Z. Li & X.Y. Ye, both also have porcate culms and tall buds, but *F. huizensis* has been included in *F. fungosa* (Yi 2014). There are several older species names that seem very likely to belong to *Borinda* rather than *Fargesia*, such as *Arundinaria forrestii*, but their vegetative parts and type localities are not well known. When they have been studied further it is expected that several other names will be added to *Borinda*, while some names may be removed or relegated to synonymy.

The 30 new combinations join 8 species from the molecular studies of Ye et al. (2019) and Zhang et al. (2019) that had already been transferred into *Borinda*, and

9 further well known *Borinda* species that were not in their analyses, to give a genus now considered to include 47 species. It would appear that the likely number of species in the genus may be around 50 when they have been properly revised, after further fieldwork and molecular studies. They possess loose, racemose to paniculate ebracteate inflorescences with robust pedicellate florets, short-necked pachymorph rhizomes, tall buds and finely ridged culms with no nodal thorns or swollen rings. By recognizing *Borinda* this treatment of *Fargesia* provides an informative generic level classification reflecting the need for plant identifiers and users to have generic combinations available that reflect important distinctions between genera, such as long-necked potentially invasive rhizomes, without demonstrable polyphyly.

Three species from the clade that resolved as sister to *Chimonocalamus* had previously been transferred to *Borinda*: *B. hsuehiana*, *B. fungosa* and *B. lushuiensis*, as they differed strongly from core *Fargesia*. They show some anomalous characteristics in *Borinda* such as short buds, lack of podium or smooth culms. As they were resolved in 'Fargesia1' (Ye et al. 2019), they are consequently no longer considered to belong in *Borinda*. A further species, *B. schmidiana* from Vietnam is now considered likely to be a species of *Yushania* instead, as it very probably has long rhizomes and spreads rather than forming clumps.

The species given new combinations are from Yunnan (22 spp.), Sichuan (6 spp.), and Tibet (*B. zayuensis*). Several are already in western cultivation and others are likely to follow as they are highly desirable. The type collections are mostly held in SIFS in Sichuan (not seen), but isotypes of many were examined and determined as *Borinda* in KUN and SWFC in 1995. Further details of synonymy, typification and type locality can be found online from Tropicos following the URLs and links provided (full details not yet available for *F. erecta* T.P. Yi, *F. muliensis* T.P. Yi and *Fargesia viridis*), and sometimes onward from links in Tropicos to other online resources such as IPNI, illustrations in Flora of China, type collections in JStor Global Plants, or protologues in BHL.

Ultimately it will be necessary to confirm the generic placement of all these names by examining further material in more depth, including voucher specimens from phylogenetic studies, type material, and new collections of flowering material when available. Meanwhile a better impression of the extent, distribution and characteristics of the genus *Borinda* is being gained, allowing a substantial improvement on previous knowledge.

Borinda acuticontracta (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia acuticontracta* T.P. Yi, J. Bamboo Res. 7(2): 98 (1988). www.tropicos.org/Name/25541680

Borinda adpressa (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia adpressa* T.P. Yi, J. Bamboo Res. 4(2): 26 (1985). www.tropicos.org/Name/25531193

Borinda altior (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia altior* T.P. Yi, J. Bamboo Res. 7(2): 65 (1988). www.tropicos.org/Name/25541667

Borinda communis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia communis* T.P. Yi, J. Bamboo Res. 7(2): 51 (1988). www.tropicos.org/Name/25541660

Borinda declivis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia declivis* T.P. Yi, J. Bamboo Res. 7(2): 101 (1988). www.tropicos.org/Name/25541681

Borinda dura (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia dura* T.P. Yi, J. Bamboo Res. 7(2): 34 (1988). www.tropicos.org/Name/25541650

Borinda elegans (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia elegans* T.P. Yi, Acta Bot. Yunnan. 14(2): 136 (1992). www.tropicos.org/Name/50092120

Borinda emaculata (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia emaculata* T.P. Yi, J. Bamboo Res. 4(2): 29–30 f. 11. 1985. www.tropicos.org/Name/25531196

Borinda erecta (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia erecta* T.P. Yi, J. Sichuan Forest. Sci. Technol. 21(1): 1 (2000).

Borinda ferax (Keng) Stapleton **comb. nov.** Basionym: *Arundinaria ferax* Keng, Sinensia 7: 408 (1936). www.tropicos.org/Name/25508566

Borinda hygrophila (Hsueh & T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia hygrophila* Hsueh & T.P. Yi, J. Bamboo Res. 7(2): 74 (1988). www.tropicos.org/Name/25541670

Borinda jiulongensis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia jiulongensis* T.P. Yi, J. Bamboo Res. 4(2): 22 (1985). www.tropicos.org/Name/25531189

Borinda mairei (Hack. ex Hand.-Mazz.) Stapleton **comb. nov.** Basionym: *Arundinaria mairei* Hack. ex Hand.-Mazz., Anz. Akad. Wiss. Wien Math.-Naturwiss. Kl. lxii. 255 (1926) in obs. www.tropicos.org/Name/25508687

Borinda muliensis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia muliensis* T.P. Yi, J. Sichuan Forest. Sci. Technol. 21(1): 1 (2000).

Borinda nivalis (T.P. Yi & J.Y. Shi) Stapleton **comb. nov.** Basionym: *Fargesia nivalis* T.P. Yi & J.Y. Shi, J. Sichuan Forest. Sci. Technol. 27(2): 47 (2006). www.tropicos.org/Name/100469638

Borinda pleniculmis (Hand.-Mazz.) Stapleton **comb. nov.** Basionym: *Arundinaria pleniculmis* Hand.-Mazz., Symb. Sin. Pt. vii. 1276 (1936). www.tropicos.org/Name/25508763

Borinda praecipua (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia praecipua* T.P. Yi, J. Bamboo Res. 7(2): 68 (1988). www.tropicos.org/Name/25541668

Borinda sagittatinea (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia sagittatinea* T.P. Yi, J. Bamboo Res. 7(2): 63 (1988). www.tropicos.org/Name/25541666

Borinda similaris (Hsueh & T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia similaris* Hsueh & T.P. Yi, J. Bamboo Res. 7(2): 25 (1988). www.tropicos.org/Name/25541646

Borinda solida (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia solida* T.P. Yi, J. Bamboo Res. 7(2): 47 (1988). www.tropicos.org/Name/25541655

Borinda stricta (Hsueh & C.M.Hui) Stapleton **comb. nov.** Basionym: *Fargesia stricta* Hsueh & C.M. Hui, Bull. Bot. Res. Harbin 18(3): 266 (1998). www.tropicos.org/Name/50149202

Borinda strigosa (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia strigosa* T.P. Yi, J. Bamboo Res. 7(2): 90 (1988). www.tropicos.org/Name/25541677

Borinda subflexuosa (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia subflexuosa* T.P. Yi, J. Bamboo Res. 7(2): 36 (1988). www.tropicos.org/Name/25541651

Borinda sylvestris (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia sylvestris* T.P. Yi, J. Bamboo Res. 7(2): 31 (1988). www.tropicos.org/Name/25541648

Borinda tengchongensis (Hsueh & C.M. Hui) Stapleton **comb. nov.** Basionym: *Thamnocalamus tengchongensis* Hsueh & C.M. Hui, Research on Bamboos from Nujiang: 96. (1994). www.tropicos.org/Name/100469668

Borinda viridis (D.Z. Li & X.Y. Ye) Stapleton **comb. nov.** Basionym: *Fargesia viridis* D.Z. Li & X.Y. Ye, PhytoKeys 170: 27 (2020). https://doi.org/10.3897/phytokeys.170.58780

Borinda xianggelilaensis (T.P. Yi, & L. Yang) Stapleton **comb. nov.** Basionym: *Fargesia xianggelilaensis* T.P. Yi, & L. Yang, J. Sichuan Forest. Sci. Technol. 34(2): 48 (2013). www.sjfsci.com/cn/article/doi/10.16779/j.cnki.1003-5508.2013.02.010

Borinda yajiangensis (T.P. Yi & J.Y. Shi) Stapleton **comb. nov.** Basionym: *Fargesia yajiangensis* T.P. Yi, & J.Y. Shi, Bull. Bot. Res. Harbin 27(5): 516 (-517; fig. 2) (2007). www.tropicos.org/Name/50312391

Borinda yulongshanensis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia yulongshanensis* T.P. Yi, J. Bamboo Res. 7(2): 87 (1988). www.tropicos.org/Name/25541676

Borinda zayuensis (T.P. Yi) Stapleton **comb. nov.** Basionym: *Fargesia zayuensis* T.P. Yi, J. Bamboo Res. 7(2): 20 (1988). www.tropicos.org/Name/25541644

NEW GENUS & COMBINATIONS IN 'FARGESIA1'

Ye et al. (2019) sampled 14 species that were initially described in *Fargesia*, but which were resolved as sister to *Chimonocalamus,* rather than with the other *Fargesia* or *Borinda* species. Zhang et al. (2019) resolved a clade in their ITS analysis that would appear to correspond to this, with 3 of the same species: *F. canaliculata*, *F. fractiflexa* & *F. fungosa*, and also adding *F. membranacea,* which was not studied by Ye et al. (2019). Several of these species had already been transferred to other genera as they did not conform to the usual characteristics of *Fargesia*. *F. membranacea* T.P. Yi was transferred to *Drepanostachyum* (Stapleton et al. 2005) because of its broad buds, obscure leaf blade tessellation and narrow culm sheaths, but it lacks the higher order branch initials seen in *Drepanostachyum*. *F. fractiflexa* T.P. Yi was similarly transferred as *Drepanostachyum fractiflexum* (T.P. Yi) D.Z. Li. *Fargesia lushuiensis* Hsueh f. & T.P. Yi also has broad buds and smooth culms, but the culms are larger and bluer than those of other species of *Fargesia*, leading to its transferral to *Borinda*. *Fargesia yunnanensis* was transferred to *Yushania* on the basis of its fairly long rhizomes, but these are quite consistent in length, and thus unusual for *Yushania*, but the panicles of this species are problematic.

Whether these rather varied species all share any unifying vegetative synapomorphic character, or whether they will be subdivided into further monophyletic taxa remains to be seen. Nearly all seem to be linked, and distinguished from *Fargesia* and *Borinda,* by inflorescence structure and a combination of three vegetative characters.

Culm bud shape is variable along the culm and often completely lacking at lower nodes, so although it varies between species it is inconsistent on its own. Nevertheless, while *Fargesia* and *Borinda* species have lower mid-culm buds that are always taller than their width, buds at similar locations in these species are usually broader. Some are tall however, or they may seem taller because of long budscale wings. They may also be closed at the front, unusual in other genera, but more detailed investigations are required.

These species all have smooth culms (Figure 2), unlike species of *Borinda,* which show finely ridged internodes. In this way they resemble *Fargesia* and *Chimonocalamus*. Their leaf vein tessellation is also obscurer, with transverse veins more visible than the longitudinal veins that they join, as in *Chimonocalamus*. Figure 3 compiles leaf blade venation from several genera, all from the same photograph. Differences in leaf vein tessellation are associated with differences in frost hardiness in these bamboos. *Drepanostachyum*, *Himalayacalamus* and *Chimonocalamus* have lower tolerance of frost than *Fargesia* and *Yushania*, and even the difference in hardiness between

Fargesia and many *Borinda* species is important in horticulture (Gielis & Oprins 2009). They also share other symplesiomorphic characters with *Fargesia* and *Borinda*, such as a lack of aerial root thorns, well developed in the sister group *Chimonocalamus*, or the variable rhizome length as seen in *Yushania*. However, it is probably the differences in inflorescence structure and culm internode surface that separate the 3 genera most reliably from a morphological perspective. The inflorescences of these species are more open and terete than the tight unilateral spathed racemes of *Fargesia*, but most of them have fewer, shorter branches (paraclades) than *Borinda*, often more erect, so that they fall into the intermediate category of small racemose panicles, and their culms are smooth.

Four such species originating in Yunnan have been introduced to western cultivation, and have become better known, two now being very widely planted, but much further study of the full range of these species in China and their detailed characteristics is required, which may take some time. Meanwhile, to accommodate the widely planted bamboos associated with 'Fargesia1', a new genus *Tongpeia* is described.

Tongpeia Stapleton **gen. nov.** Rhizomes pachymorph, necks to less than 30(-50)cm. Culms self-supporting. Internodes terete or mildly sulcate, usually smooth, rarely lightly porcate, purple spots absent or obscure. Nodes not raised, with thin persistent sheath base, supranodal ridge not substantially raised, without prominent root initials. Mid-culm buds usually broadly ovate to ovate, with reduced sheathing, higher orders of branching not arising in first year, promontory short or lacking. Mid-culm branches several to many, subequal, leaf insertion indeterminate, leaf blade venation obscurely tessellate. Inflorescence a racemose panicle or panicle, ebracteate, without basal enclosing spathes, not secund. Type species: *Tongpeia arachnoides* Stapleton. Etymology: in honour of Professor Yi Tong-Pei (1933–2016), who discovered and described most of the species in *Fargesia* and *Yushania*, travelling extensively and undertaking scientific research at a time when this was very difficult in China, providing detailed descriptions of scores of new species from Sichuan, Yunnan, and SE Tibet.

The characteristics of 15 related genera are presented in Table 2, which lists the states for the characters that are most informative at the generic level for the 14 pachymorph genera, adding the leptomorph genus *Sarocalamus,* as it was resolved within a clade along with the pachymorph genera. It is now possible to separate the pachymorph-rhizomed genera for the purpose of identification of cultivated species using a morphological key, although it still requires testing against a wider range of species in China (Key 1).

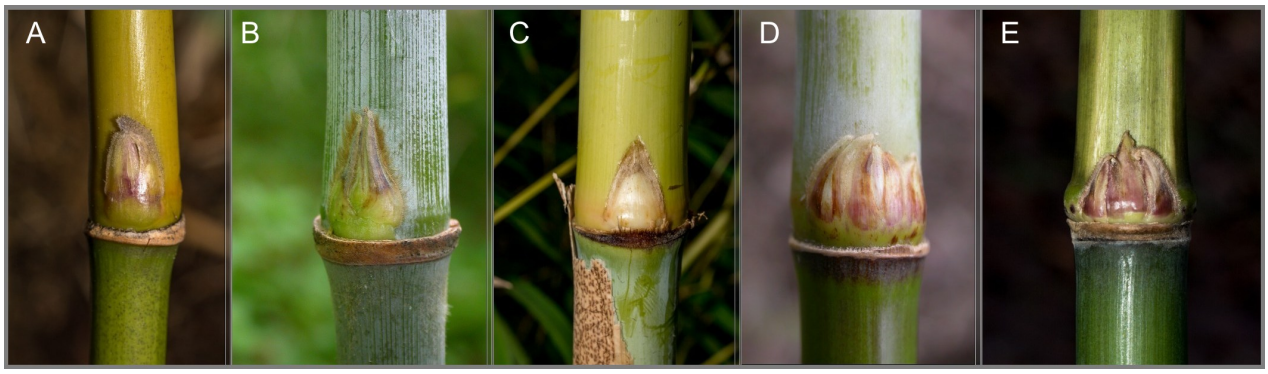

Figure 2. Lower mid-culm buds. **A.** *Fargesia robusta* **B.** *Borinda macclureana* **C.** *Tongpeia arachnoides* **D.** *Tongpeia syrinx* **E.** *Chimonocalamus pallens*

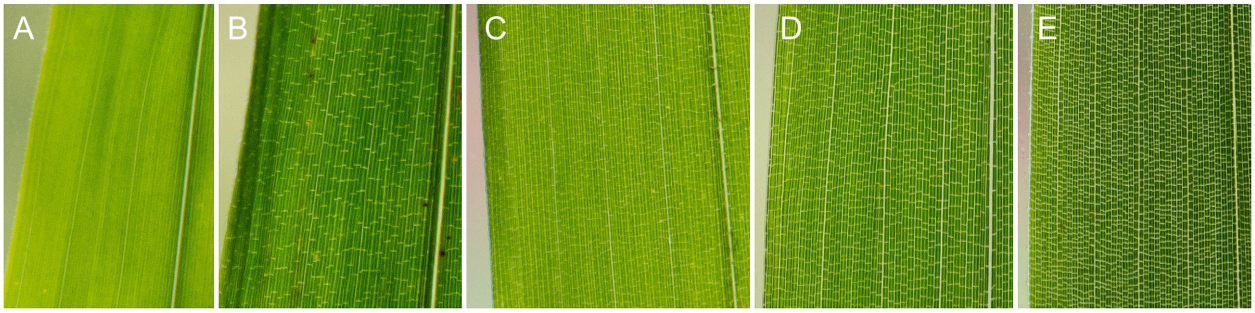

Figure 3. Leaf blade vein tessellation. **A.** *Himalayacalamus cupreus* **B.** *Chimonocalamus pallens* **C.** *Tongpeia arachnoides* **D.** *Borinda contracta* **E.** *Fargesia dracocephala*

	Yushania	Borinda	Fargesia	Bergbambos	Sarocalamus	Thamnocalamus	Tongpeia	Chimonocalamus	Kuruna	Oldeania	Drepanostachyum	Himalayacalamus	Ampelocalamus	Gaoligongshania	Hsuehochloa
rhizomes short=0; long-necked=1; leptomorph=2	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0
culms semiscandent=0; self-supporting=1	1	1	1	1	1	1	1	1	1/0	1	1	1	0	0	0
nodes not swollen=0; swollen=1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
without root thorns=0; with thorns=1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
girdle absent=0; girdle present=1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
supranodal ridge obscure=0; developed=1; prominent=2	0	0	0	0	0	0	0	2	0/1	2	0	0	0	0	0
culm internodes terete=0; sulcation slight=1; moderate=2	0	0	0	1	0	1	0	2	0/1	1	0	0	0	0	0
smooth=0; finely ridged=1	0/1	1	0	0	0	0	0/1	0	0	0	0	0/1	1	0	0
lower mid-culm buds height ⩾ width=0; height < width=1	0	0	0	0	0	0	1/0	0	0?	1	1	1	1	0	?
sheathing complete=0; reduced=1	1	1	1	1	0	0	1	1	0	1	1	1	1	0	?
mid-culm 1st yr branches few=0; several=1; many =2	1	1	1	1	0	1	1/2	0	1	1	2	1/2	1	0	0
leaf sheath blade tessellation none=0; obscure=1; strong=2	2	2	2	2	2	2	1	2	2	2	0	0	0	2	0
synflorescence panicle=0; racemose panicle=1; raceme=2	0	1	2	2	0	1	1	0	1	0	0	2	0	0	2
not unilateral=0; unilateral=1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
synflorescence branches (paraclades) substantially bracteate=0; ebracteate=1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	?

Table 2. Informative generic characters of 15 'Pachymorph temperate clade' genera

1 Leaf blade with well developed transverse veinlets 5
1 Leaf blade without transverse veinlets
2 Culm nodes with thick persistent sheath base or girdle ..... *Ampelocalamus*
2 Culm nodes with thin persistent sheath base and no girdle
3 Culm sheath abaxial distally pubescent, inflorescence paniculate ..... *Drepanostachyum*
3 Culm sheath abaxial surface glabrous, inflorescence racemose
4 Self-supporting, several branches ..... *Himalayacalamus*
4 Scrambling, solitary branches ..... *Hsuehochloa*
5 Rhizome necks to less than 50cm 7
5 Rhizome necks to more than 50cm
6 Internodes strongly sulcate above branches, Africa & Madagascar ..... *Oldeania*
6 Internodes not strongly sulcate above branches, Asia ..... *Yushania*
7 Mid-culm branch solitary, as large as culm ..... *Gaoligongshania*
7 Mid-culm branches multiple, smaller than culm
8 Root initials/thorns at lower nodes, supranodal ridge prominent ..... *Chimonocalamus*
8 No or few root initials/thorns at lower nodes, supranodal ridge obscure
9 Branch sheaths reduced, some sheaths absent 11
9 Branch sheaths all present
10 Inflorescence basally spathed, Himalayas ..... *Thamnocalamus*
10 Inflorescence not basally spathed, Sri Lanka & S India ..... *Kuruna*
11 Oral setae delicate, S. Africa ..... *Bergbambos*
11 Oral setae robust or absent, Asia
12 Inflorescence a secund raceme, culms smooth, tessellation strong ..... *Fargesia*
12 Inflorescence a panicle or racemose panicle, not secund
13 Culms finely ridged, leaf blade tessellation strong ..... *Borinda*
13 Culms smooth, leaf blade tessellation weak ..... *Tongpeia*

Key 1: Pachymorph genera of the temperate bamboo clade

Species of *Fargesia* in western cultivation that can now be excluded from *Fargesia* and *Borinda*, having weak tessellate leaf venation, short buds, or smooth culms, so that they would be placed in *Tongpeia,* include two widely planted but apparently new species. Somewhat similar are two much rarer species, grown under the names *Fargesia lushuiensis* and *Yushania addingtonii* Demoly, the characters and placement of which remain somewhat uncertain at this stage. The two new species described here were both sent from China under the name *Fargesia fungosa*, amongst other names, although they both have characters that seem to distinguish them from that species as described, notably the prominently fimbriate ligules, an unusual character which they share with *F. weiningensis* T.P. Yi & L. Yang. There appears to be some lack of certainty within China as to the precise characteristics of *F. fungosa. F. huizensis* was described with much shorter culms sheaths, glabrous leaves and ridged culms, yet was still considered a synonym of *F. fungosa* (Yi 2014), although the type apparently could not be located. Further, more detailed investigations into the characteristics of all species from this group are required in China, which may take some time. Meanwhile full descriptions are given for the two widely planted species in western cultivation, which now need to be compared to *F. fungosa* in China, and a new combination is also made here in *Tongpeia* for *F. fungosa.* These species now have names outside *Fargesia*, which allows more satisfactory names and descriptions for them, but also for the other 2 groups of species that have been grown in western cultivation under the name *Fargesia*: those remaining in *Fargesia s.s.* from clade 'Fargesia2', and those in *Borinda*.

1. Tongpeia arachnoides Stapleton **sp. nov.** (Figure 4); *Fargesia yunnanensis* Hort., *non* Hsueh & T.P. Yi. Type: UK, Amersham (cult.), Stapleton 1412, 22 ii 2021 (holo. WSY), ex Yunnan, sent as seed by Yunnan Bamboo Nursery, FMXG (as *Fargesia yunnanensis* Hsueh & T.P. Yi).

Related to *Fargesia fungosa* T.P. Yi but differing in its larger leaf sheath auricles and its radiating, rather than erect oral setae, its long-fimbriate rather than ciliate leaf sheath ligule, and scarcity of pithy sponge in the internode cavity.

Plants forming dense clumps. Rhizomes pachymorph, neck to 15 cm. Culms nodding to pendulous, probably to ca. 6 m tall; internodes terete, to 15–25(–30) cm, to ca. 2.5 cm in diam., bright green with light deciduous blue-grey wax at first, becoming yellow-green, or red to dark purple after exposure, smooth, glabrous, walls thick, cavity with some pithy sponge only at most basal nodes; nodes not prominent, supra-nodal ridge obscure, sheath scar prominent, initially lightly tomentose; branches initially 5–9, subequal, strong, angular, becoming nearly horizontal. Culm sheaths very persistent, much longer than internodes, to 40 cm, narrowly triangular, distally very thin, basally thick-papery, initially light green, variably purple-spotted and blotched at first, sparsely to densely and persistently purple-setose, each bristle in a dark spot or blotch; apex of new shoots initially broad and inflated with loose sheaths, often pink to purple; margins prominently long-ciliate; base glabrous or with sparse hairs; auricles to 1 mm, reflexed, an undulating band merging into blade base, purple, tomentose; oral setae absent; ligule to 3 mm, fimbriate, tomentose; blade small, short, lanceolate, glabrous, erect or reflexed, deciduous. Leaf sheath often distally pink-purple, glabrous but distal margins lightly pubescent and apically shortly ciliate, shoulders level; auricles large, falcate, reflexed, often purple; oral setae 0–3 erect each side of pseudopetiole, 6-10 spreading from each auricle, straight or wavy, white, to 10 mm; ligule truncate, to 1 mm, densely tomentose to pilose, long-fimbriate to 5mm on larger leaves, to ciliate on smaller leaves; external ligule to 0.5 mm, tomentose, shortly ciliate; blade to 12

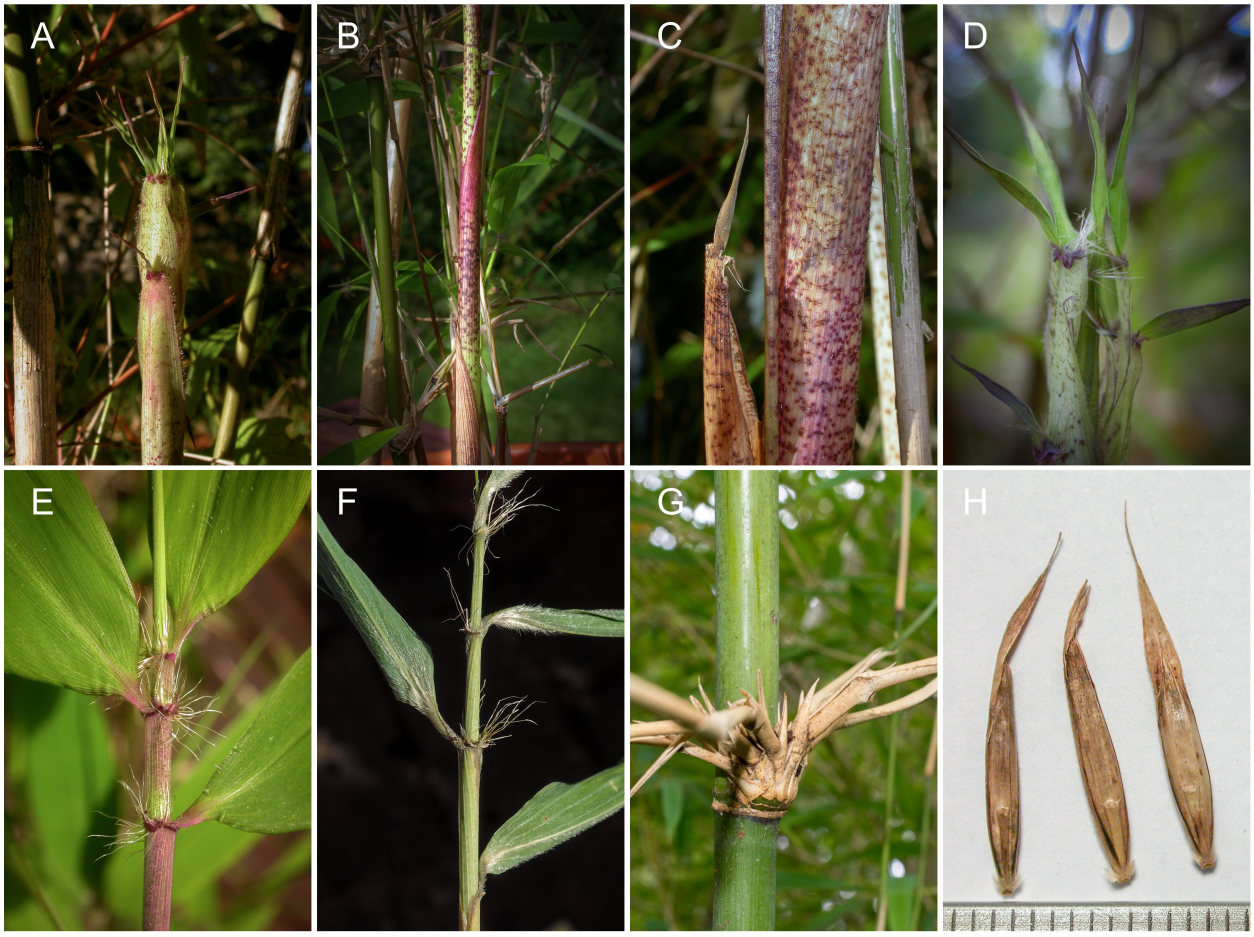

Figure 4. *Tongpeia arachnoides*. **A**. Shoot apex. **B**. Culm sheaths lower down shoot. **C**. Culm sheath with fimbriate ligule and small blade. **D**. Culm sheaths with wavy auricles. **E**. Leaf sheaths with adaxial blade surface. **F**. Older leaf sheaths with abaxial blade surface. **G**. Horizontal branches in first year. **H**. Florets (scale sections 1mm).

cm, lanceolate to broadly lanceolate, light green, base rounded to cuneate, abaxial very shortly pilose to proximally densely pilose and extremely densely pilose to 1mm by basal midrib and on pseudopetiole, adaxial initially sparsely to densely pilose, secondary veins 3–4-paired, vein tessellation obscure, margins spinescent-serrulate. Florets with basal ring of tufted white hair; lemma much longer than palea, to 15–25mm, apically shortly ciliate and sparsely scabrous to pilose, long-mucronate and dorsally keeled; palea 10–15mm, keels distally scabrous to acute apex, distally pubescent between keels; rhachilla c. 3mm, basally glabrous, distally pilose; caryopsis 9–12mm.

Etymology: from *arachnis* G., spider, for the spidery oral setae of the leaf sheaths.

Distributed naturally in C & W Yunnan, China. Its seed was reportedly collected in quantity across Yunnan, from Songming near Kunming to Lijiang. Marketed globally online as seed directly from Kunming or indirectly to plant growers and collectors in very many countries, from 2011 onwards, initially under the misapplied name *Fargesia yunnanensis*, but later under ten other misapplied or unpublished species names as well, including notably *Fargesia fungosa* and *Fargesia papyrifera*.

2. Tongpeia fungosa (T.P. Yi) Stapleton **comb. nov.**
Basionym: *Fargesia fungosa* T.P. Yi, *Bull. Bot. Res., Harbin* 5(4): 121 (1985). www.tropicos.org/name/25541705

3. Tongpeia syrinx Stapleton **sp. nov.** (Figure 5); *Fargesia fungosa* Hort., *non* T.P. Yi.

Type: UK, Amersham (cult.), Stapleton 1413, 22 ii 2021 (holo. WSY), ex Yunnan sent as seed by Professor Hsueh Ji Ru of Southwest Forestry University, Kunming (as *Fargesia fungosa* T.P. Yi).

Related to *Tongpeia arachnoides* but differing in its total absence of leaf sheath auricles, very erect leaf sheath oral setae, thicker, less setose culm sheaths with larger blades, and less densely pubescent leaf sheath blades and pseudopetioles.

Plants forming dense clumps. Rhizomes pachymorph, neck to 12cm. Culms erect to nodding, to 5m, 1–2 cm in diam.; internodes to 18cm, cylindrical, very smooth, basally white-powdery initially, becoming yellow or brown with

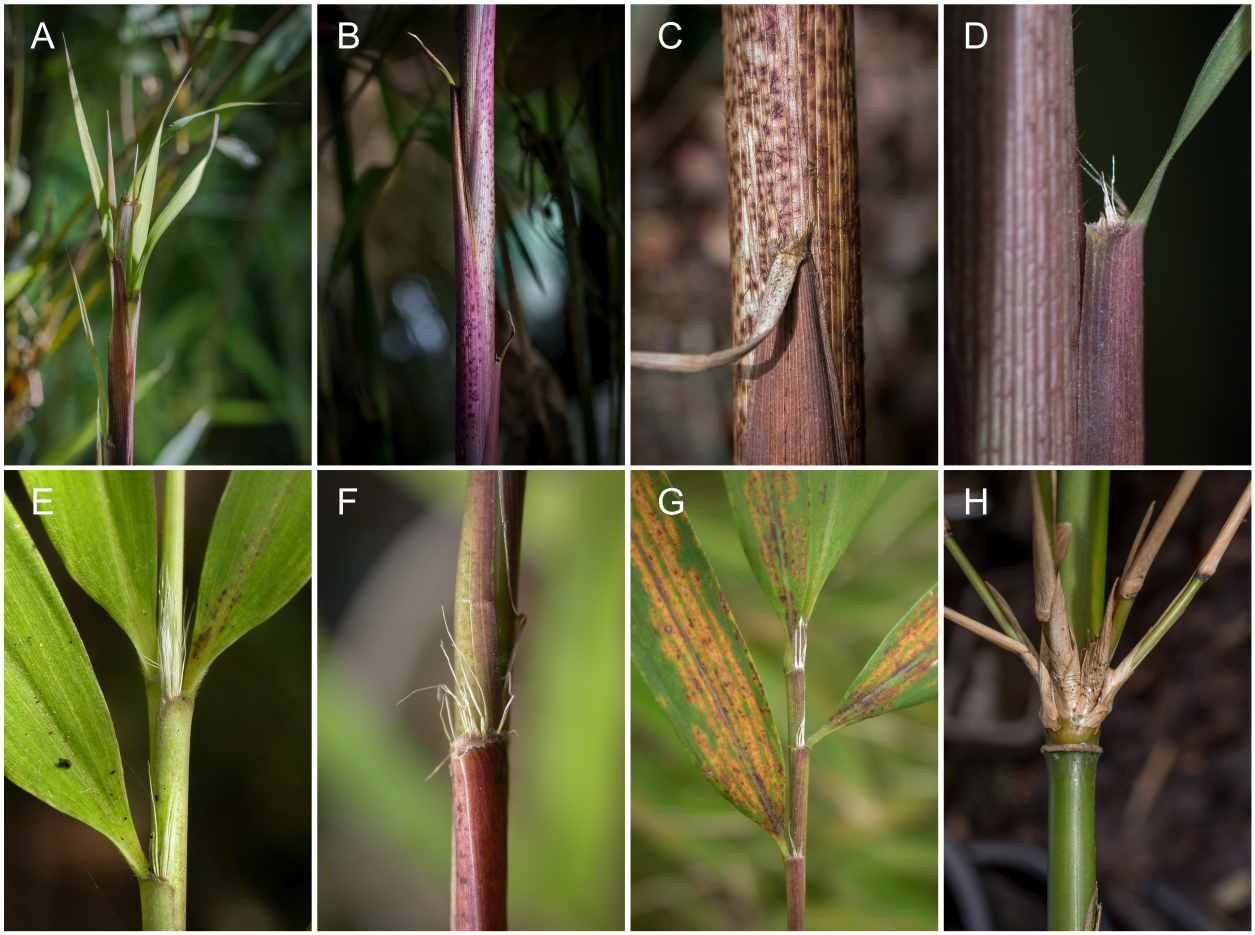

Figure 5. *Tongpeia syrinx*. **A**. Shoot apex. **B**. Culm sheaths lower down shoot. **C**. Culm sheath with fimbriate ligule. **D**. Culm sheath apex with no auricles. **E**. Young leaf sheaths. **F**. Partially fimbriate leaf sheath ligule, oral setae removed. **G**. Old leaf sheaths. **H**. Mid-culm branches in first year.

exposure, wall thick; nodes with light supra-nodal ridge, sheath scar inconspicuous, shortly tomentose, branches initially 5–9, straight, at c. 45º. Culm sheaths persistent, longer than internode, narrowly triangular, basally leathery, distally papery, brown to dark-brown setose at first, yellow-brown with dense purple-brown spots around each seta, distally glabrous, margins very shortly ciliate, apex of new shoots slightly inflated; auricles absent; oral setae absent or very few, erect, deciduous; ligule ca. 1 mm, truncate, tomentose, densely long-fimbriate to 1.5cm; blade deciduous, linear-lanceolate. Leaf sheath shortly tomentose, overlapping margin apically initially ciliate, shoulders sloping convexly or level, more level on basal sheaths; auricles absent; oral setae 8–14, erect, to 6mm, white, straight, densely packed, persistent; ligule obliquely truncate, ca. 0.5mm, shortly ciliate by lower, overlapping margin often becoming to 4mm fimbriate by higher, inner margin, tomentose; external ligule to 0.3mm, glabrous, minutely ciliate; blade narrowly lanceolate, 10–14 × 0.8–1.2cm, base cuneate, abaxial tomentose to proximally densely pilose beside midvein, adaxial glabrous to sparsely shortly pilose, secondary veins 4-paired, vein tessellation obscure; petiole pilose.

Etymology: from *syrinx* G., panpipes or pan flute, for the prominence and arrangement of the tightly packed array of straight white erect leaf sheath oral setae, especially when the leaf sheath shoulder slopes.

Distribution: Collected as seed from an unknown location in Yunnan by Prof. Xue Ji-Ru (J.R. Hsueh) of SWFC in Kunming, who worked closely with Prof. Yi Tong Pei. Seed sent as *Fargesia fungosa* T.P. Yi in 1989 to Holland and to the USA, where it is now widely grown especially in California.

INCERTAE SEDIS

Rare species in western cultivation apparently allied to *Tongpeia* rather than *Fargesia*, *Yushania* or *Borinda*, but requiring further investigation.

1. Fargesia lushuiensis Hsueh & T.P. Yi, *J. Bamboo Res*. 7(2): 111 (1988); *Borinda lushuiensis* (T.P. Yi) Stapleton.
www.tropicos.org/name/25541684

Collected by Shanghai Botanic Garden collectors for a Dutch nursery, sent as Yunnan 95 #4 under the name *Fargesia edulis*, and only tentatively identied in the UK as *F. lushuiensis*, this has smooth culms reaching 12m in height with broad buds, appearing similar to *Himalayacalamus*, but with fewer branches and larger leaves with tessellate venation.

2. Yushania addingtonii Demoly, *Acta Bot. Gallica* 153(3): 335 (2006).
https://www.tropicos.org/name/100457981

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