BULL. BOT. SURV. INDIA
Vol. 12, Nos. 1-4 : pp. 242-254, 1970

BIOSYSTEMATIC STUDIES ON INDIAN COMMELINACEAE—THE CHROMOSOME PATTERN AND EVOLUTIONARY TRENDS

ROLLA SESHAGIRI RAO, R. SUNDARA RAGHAVAN* AND R. V. KAMMATHY†

Botanical Survey of India, Shillong

ABSTRACT

At present the family Commelinaceae in India comprises 80 species under 10 genera excluding, however, all ornamental and cultivated species which are mostly exotic. While revising the family an attempt has been made to blend classical taxonomy with experimental taxonomy and to analyse as to how far the other allied fields help for a better understanding and interpretation of the many ambiguities and "species complex" that could not be solved by the earlier herbarium methods of study. This co-ordinated approach has certainly vindicated the splitting up of *Cyanotis* (*sensu lato*) into three distinct genera, separation of *Murdannia* from *Aneilema*, retention of *Aclisia* under *Pollia* and possibly justifies the resurrection of *Dictyospermum* and creation of a new genus *Tricarpelema*. Further, the studies have thrown light on the evolutionary trends in progress in *Commelina*, *Cyanotis*, *Murdannia* and *Aneilema*, the role of aneuploidy in speciation and as to how the polyploids through genetic isolation have played a major role in the evolution of new taxa thus enabling to invade new territories. The cosmopolitan *Commelina erecta* that is widespread from N. Australia to Africa through Malaysia, India and Ceylon exhibits a wide range of polyploidy (n = 30,45 to 60) which perhaps accounts for its extreme diversity. The close similarity of the diploids and polyploids possibly suggests autopolyploidy but at least in some species of *Murdannia*, as in *M. vaginata*, *M. loriformis* and *M. simplex*, the presence of dissimilar bivalents suggests allopolyploidy. In *Cyanotis* (*sensu stricto*) genetic and geographical isolation have permitted accumulation of differences leading to taxonomic diversification and new species have evolved mostly through aneuploidy. The genus *Belosynapsis* which is an off-shoot from a *Cyanotis* ancestor has a different habitat altogether and all the three species of the genus (two Indian and one Malesian) are distinctly epiphytic or lithophytic. In some cases the new gene combinations have been successfully retained by vegetative propagation either by proliferating at the nodes (as in *Cyanotis adscendens*) or through development of underground bulles (as in *Cyanotis arachnoidea* var. *thwaitesii* and *Murdannia juncoides*) and as a result, the annuals have turned into perennials. A tentative phylogenetic chart is presented indicating possible lines of evolution within the family.

During the last two or three decades there is an artificial widening breach between classical taxonomy and biosystematics, mainly stemming from our narrow approaches to the problems of evolution, variation and phylogeny. The conservative taxonomists deal with the morphologically circumscribed taxa which are the end products whereas the biosystematists concern themselves with the main evolutionary processes at work and do not attach much importance to the end products. "Biosysematics or experimental taxonomy" as understood by many, has been primarily concerned with such subjects as chromosome details (haploidy, polyploidy, aneuploidy, karyotypes), pairing behaviour, hybridisation (inter-generic, inter-specific or amphi-diploids) artificial manipulation of genes, role of sterility apomixis etc. though in a wider sense it should embrace some of the orthodox fields as palynology, embryology, anatomy etc. also. Of late, computers as well as refined biochemical techniques have ushered in new promising fields as numerical and chemo-taxonomy. Biologists are apt to forget that the essential advance of systematics is based on a correlated integration of both the classical as well as modern approach.

A taxonomist is primarily concerned with the principal clusters of diversity in nature namely subspecies, species, genera etc. and in angiosperms alone he has to deal with over a quarter million different species with the result, a phenetic classification alone is possible and a phyletic classification is virtually impossible. However, a monographer dealing with a limited group of plants is as much concerned with evolutionary processes and species population as any biosystematist and takes into consideration correlated data from cytology, genetics, anatomy palynology, ecology, plant geography and even geology to supplement the morphological data. The present revision of Commelinaceae is an attempt towards this goal and it has certainly helped for a better appreciation of the inter-relationship of the various genera, delimitation of the species within a genus and evolutionary trends in progress.

Commelinaceae affords an excellent group for

Present address : *Botanical Survey of India, Poona.
†Botanical Survey of India, Calcutta.

a study of variation and speciation especially in a tropical country as the various species are still in an active evolutionary change. Though classical taxonomy has been the back-bone of the present revision, for which critical study of more than ten thousand herbarium specimens in India and abroad including most of the *types* besides extensive field-work all over India covering many of the type localities has been carried out, every effort has been made to present a synthetic biosystematic approach taking supplementary data from cytology, anatomy, palynology etc. besides cultivating the species at Poona under uniform environmental conditions. The results are briefly summarised below. (See also chromosome number list and chart showing suggested evolutionary trends).

A. Tribe **Commelineae**

In India, this comprises of genera such as *Commelina* Linn., *Murdannia* Royle and *Aneilema* R. Br. the latter genus embracing *Dictyospermum* Wt. and *Tricarpelema* Morton but excluding the African elements.

1. COMMELINA LINN.

This is the largest genus in the family comprising over 200 species, the distribution extending throughout the tropical and subtropical World, the main centres being Africa and Asia. Hardly 46 species have been cytologically worked out throughout the World and in India, of the 23 species represented, 19 have been studied.

Treating the genus as a whole, species with x=15 dominate accounting for nearly 90% of the populations. Such basic numbers as x=10 (*C. macrosperma* Morton), x=11 (*C. benghalensis* Linn.) x=12 (*C. attenuata* Koen. ex Vahl), x=13 (*C. eckloniana* Kunth) & x=14 (*C. lateriticola* A. Chev.) are confined to a few species only. Inter and infra-specific polyploidy is widespread in this genus. Infra-specific aneuploidy is quite rare and is confined to the African species only and at any rate not represented in India. In the x=15 group of species. twice as many polyploids are known as there are diploids but in species with basic numbers as x=10, 11, 12, 13 & 14 invariably all are diploids, the exception being *C. benghalensis* where tetraploids and hexaploids are known.

In India, 17 out of the 19 species studied have x=15, the only exceptions being *C. benghalensis* (x=11) and *C. attenuata* (x=12). Even in this group with x=15 or its multiples, the polyploids far outnumber the diploids; the diploids are represented by only five species whereas amongst the polyploids, four species have n=30, seven species n=45 and one species each has n=75 & 60 respectively. Infra-specific polyploidy could be substantiated only in **C. erecta* Linn. (=*C. undulata* R. Br.). Eight species *viz. C. albescens* Hassk., *C. benghalensis* Linn., *C. diffusa* Burm. f., *C. forskalaei* Vahl, *C. imberbis* Ehrenb. ex Hassk., *C. kotschyi* Hassk., *C. subulata* Roth and *C. erecta* Linn. are common to both India and Africa; but except for *C. diffusa* and *C. forskalaei* the populations reveal varying degrees of polyploidy in the two regions. In *C. benghalensis* and *C. imberbis* only diploids have been noted in India whereas diploids and tetraploids (or even hexaploids) are common in Africa. Diploid races of *C. subulata* so frequent in Africa could not be substantiated in India but curiously enough, the tetraploid form of this species is unknown outside India. The Indian races of *C. erecta* are invariably either hexaploids (n=45) or octoploids (n=60) but the African populations reveal 2n=60 (Lewis, 1964) though Morton (1967) also records such varying numbers as 2n=56, 58 & 112 for a few populations from Ghana. The single Indian population of ***C. albescens* studied reveals n=15, in contrast to n=30 in Africa. The report of n=24 for *C. attenuata* from India is unique, for such a number has not been reported for any other species of *Commelina* so far.

In general our findings in India are in complete agreement with that of Lewis for the 26 African species studied by him and run counter to Morton's assessment of x=14 for a majority of the African species. In fact, Morton himself at the Tenth International Botanical Congress (Edinburgh, 1964), has confirmed the prevalence of x=15 for some of the species earlier worked out by him. We fail to substantiate the few observations of n=14 recorded for

*After further analysis of more American material of *C. erecta* Linn. and other allied taxa from Africa, Morton (1967) indicates that *C. erecta* Linn. is the correct name for this extremely variable and extensively distributed species capable of extreme adaptability, including *C. undulata* R. Br. (Rolla Rao 1966), Brenan (1968) accepts this view. Our recent check up at Kew (Raghavan 1971) also confirms this point. However, formation of sub-species in African populations by Morton (1967) may not be quite helpful as the variations are very much intergrading in this cosmopolitan species. *C. erecta* with its distribution from tropical America to Australia through Africa, India and Malaysia is an interesting complex species and seems to be in a very active state of evolution.

**Even this species is considered by Morton (1967) as an extreme desert variant of *C. erecta* Linn. However, this needs further study in view of the authors' experience with living populations of *C. albescens* from Rajasthan desert.

C. diffusa and *C. forskalaei* in India by some workers. We differ from Morton's views that polyploidy has not played a major part in the speciation of *Commelina.*

Interestingly enough, Lewis (1964) contends that the newly reported basic number of x=13 in the genus *Commelina* lends additional support to Woodson's (1942) contention for the merging of *Commelinantia* Tharp (x=13) under *Commelina.* However *Commelinantia* differs from other genera in having pollen with 3 colpi (Rowley, 1959) and further the basic number of 13 is quite rare in *Commelina* proper.

The basic number x=15 is certainly of secondary origin and shares a close affinity with *Murdannia* with a characteristic number x=10.

2. Murdannia Royle

Murdannia is mainly centred in Asia but fairly well represented in Africa, extending to China, Japan, Australia and Pacific islands. This genus is closely allied to *Aneilema* (including *Dictyospermum* Wt. and *Tricarpelema* Morton), is more primitive and probably both arose from a common stock. Though earlier this genus was included under *Aneilema* R. Br. only (*sensu lato*), the distinctness of *Murdannia* from *Aneilema* is well supported by morphological, anatomical, palynological and cytological data. In India, 17 of the 23 recognised species have been cytologically worked out and outside India only 4 species have been studied, of which *M. simplex* (Vahl) Brenan and *M. nudiflora* (Linn.) Brenan are cosmopolitan. Of the 17 Indian species studied, a majority of twelve species have n=10, or its multiples, two species have n=9, two species have n=6 or 12 and one species has n=11. In n=10 group of species, even as in *Commelina,* the polyploids outnumber the diploids by 2:1, eight species revealing n=20 to 40, while only 4 species have n=10. Aneuploidy could be substantiated beyond doubt only in *M. elata* (Vahl) Bruckn. Infra-specific polyploidy (including aneuploidy) has been observed in 6 species only *viz. M. elata* (n=20, 21 & 32), *M. gigantea* (Vahl) Bruckn. (n=11, 22), *M. semiteres* (Dalz.) Sant. (n=6, 12), *M. simplex* (n=20, 30, 40), *M. spirata* (Linn.) Bruckn. (n=10, 20) and *M. ochracea* (Dalz.) Bruckn. (n=18, 30). The dominant line of descent is n=10. Both *Commelina* and *Murdannia* show a close parallel in the chromosome pattern and distribution and wide prevalence of inter and infra-specific polyploidy; but aneuploidy is comparatively much more common in *Murdannia* than in *Commelina* proper. The presence of abrupt dissimilar bivalents in *M. vaginata* (Linn.) Bruckn., *M. loriformis* (Hassk.) Rolla *et* Kammathy and *M. simplex* indicates allo-polyploidy and possibly intergeneric hybridization, which are however to be substantiated by further genetic studies. Although the common basic number of *Commelina* and *Murdannia* differ, *i.e.* x=15 & x=10 respectively, both have very small chromosomes and a prototype of x=5 is suggested for these two genera.

3. Aneilema R. Br.

Aneilema as defined by Morton (1966) is predominantly tropical African with distribution extending to Australia and South America but does not occur in India at all. According to him the various Indian species hitherto included under *Aneilema* (*sensu stricto*) should fall under *Dictyospermum* Wt. or *Tricarpelema* Morton only. *Dictyospermum* Wt. resuscitated by Morton, is essentially Asian in distribution and occurs in India as well as in S. E. Asia. On the other hand, *Tricarpelema* Morton is exclusively confined to the Indian subcontinent only. The present studies are inclined to support Morton's revival of *Dictyospermum* Wt. and the erection of the new genus *Tricarpelema* Morton, but it would be preferable to study all the East Indian species that are now included under *Aneilema* (*sensu stricto*) before drawing any definite conclusion. It would appear that the recently described species of *Aneilema glanduliferum* Joseph *et* Rolla from Arunachal Pradesh would belong to *Tricarpelema* only and if so, the genus may not be monotypic as indicated by Morton. Our knowledge on the Eastern Indian species of *Aneilema* is yet incomplete and pending further critical studies the Indian species have been retained under *Aneilema* R. Br. only as understood at present.

According to Morton, the West African species of *Aneilema* which are different from the Indian species, exhibit a wide range of basic numbers which include x=9, 10, 13, 15 & 16(8) but of the 13 species worked out by him, 10 species have x=13 which is the most frequent basic number. In India 7 species of *Aneilema* (as understood at present) occur of which four are exclusively Eastern Indian in distribution, two confined to Peninsular India only and one species occurs common to both the regions. Of the various species that fall under section *Dictyospermum* Wt., a basic number of x=7(14) is indicated for the Penisular Indian species *i.e. A. mon-*

tanum Wt. (n = 14) and *A. ovalifolium* (Wt.) C. B. Cl. (n = 14); *Aneilema scaberrimum* (Bl.) Kunth (n = 29) which is distributed in both Eastern and Peninsular India is an aneuploid derivative from x = 7. Of the Eastern India species, only *A. thomsoni* C. B. Cl. [included by Morton under *Tricarpelema thomsoni* (C. B. Cl.) Morton] has been worked out which has n = *ca* 24. Thus Morton's treatment of *Aneilema* as a heterogenous mixture comprising of at least 3 distinct genera, seems to find tentative support in the different basic numbers exhibited by these genera [*Dictyospermum* x = 7(14); *Tricarpelema* x = *ca* 24; *Aneilema* x = 13 besides, 9, 10, 15 & 16].

B. Tribe **Tradescantieae**

In India six genera *viz. Amischophacelus* Rolla et Kam., *Belosynapsis* Hassk., *Cyanotis* D. Don, *Floscopa* Lour., *Streptolirion* Edgew. and *Amischotolype* Hassk. (=*Forrestia* A. Rich.) belong to this tribe. Possibly this tribe arose from a prototype with x = 6 in contrast to x = 5 prevalent in Commelineae.

CYANOTIS (*sensu lato*)

The similar epidermal pattern in all the species analysed so far, indicates their close affinity and origin from a common stock, though on the basis of distinct morphological data corroborated by cytological studies this has been split up into *Amischophacelus, Belosynapsis* and *Cyanotis* (*sensu stricto*).

1. AMISCHOPHACELUS ROLLA RAO AND KAMMATHY

This genus is represented by only 2 species which are confined to tropical regions as far as Malesia and Africa and recently reported occurring in West Indies as well. The few-flowered sessile cymes concealed within the leaf-axils with inconspicuous bracts and bracteoles, a different basic number of x = 10 and an altogether distinct karyotype as compared to any species of *Cyanotis*, all warrant the elevation of section Ochreaflora of *Cyanotis* into a separate genus *Amischophacelus*. In India, both *A. axillaris* (Linn.) Rolla *et* Kam. and *A. cucullata* (Roth) Rolla *et* Kam. occur which reveal x = n = 10.

2. BELOSYNAPSIS HASSK.

This genus is represented by 3 species of which 2 occur in India. The characteristic epiphytic or lithophytic habit, one to few flowered cymules on small peduncles without biseriate imbricate bracts and a haploid number of n = 26, justify the generic status accorded to the Dalzellia section of *Cyanotis*. The basic number of x = 13(26) is also exhibited by a few species of *Cyanotis*. Possibly these and the genus *Belosynapsis* evolved from a common ancestor.

3. CYANOTIS D. DON (*sensu stricto*)

A genus of about 55 species widely represented in Asia and Africa of which hardly 20 species have been cytologically worked out.

Amongst the 20 species worked out 16 species have a basic number of x = 12 (in 3 species, besides x = 12, a few populations reveal such secondary basic numbers as x = 11, and 13 also). The only exceptions are a few African species such as *C. polyrrhiza* Hassk. (x = 11), *C. foecunda* Hassk. (x = 13), *C. somaliensis* C. B. Cl. (x = 14) and *C. speciosa* (Linn. f.) Hassk. (x = 13, 13+1, 15). In India of the 15 species that occur, 14 species have been worked out and a basic number of x = 12 has been recorded for all the species without exception. Unlike the situation in *Commelina*, inter-specific polyploidy is very much restricted confined to *C. concanensis* Hassk. (n = 36) and *C. adscendens* Dalz. (n = 24) only. Infra-specific polyploidy could be observed only in *C. tuberosa* (Roxb.) Schult. f. (n = 12, 24). A few populations of *C. arachnoidea* C. B. Cl. & var. *thwaitesii* Rolla *et* Kam. (n = 11, 12, 13) and *C. villosa* Schult. f. (n = 12, 13) reveal an evolutionary trend towards infra-specific aneuploidy which however is widespread and of greater frequency in Africa. Recently Panunganti (1971) working on *C. villosa* confirms the occurrence of chromosomal races with n = 12 & 13 and postulates that the latter originated from the former as a tetrasomic in the first instance followed by structural differentiation.

4. FLOSCOPA LOUR.

This is a genus of about 25 species mostly centred in tropical Africa with extensions into Asia and South America but cytologically little worked out. In India only *F. scandens* Lour. occurs which reveals n = 12. Morton records the following numbers for the West African populations: *F. africana* C. B. Cl. subsp. *africana*, 2n = 36; *F. africana* var. *petrophila* Gilg. et Ledermann ex Morton, 2n = 18; *F. glomerata* Hassk. subsp. *pauciflora* (C. B. Cl.) Morton 2n = 18; *F. aquatica* Hua 2n = 12 and *F. axillaris* (Poir.) C. B. Cl. 2n = 12. According to Morton the primary basic number appears to be x = 6 with a secondary basic number of x = 9 also.

5. AMISCHOTOLYPE HASSK. (=FORRESTIA A. RICH.)

This genus is mostly Malesian in distribution and is poorly represented in India. The only Indian species *A. mollissima* (Bl.) Hassk. var. *marginata* (Bl.) Rolla Rao worked out so far shows 2n = 36. The other African species studied, *A. tenuis* (C. B. Cl.) Rolla Rao (=*Forrestia tenuis*) reveals 2n = 18. The basic number appears to be x=9.

6. Streptolirion Edgew.

The genus is represented in India by *S. volubile* Edgew. which exhibits n=6. A few populations from Khasia hills which are distinctly hairy and considered as var. *khasiana* C.B.Cl. reveal n = 5 and this is secondarily derived from n = 6 forms.

C. Tribe **Pollieae**

Pollia Thunb.

This is a small genus occurring in tropical Africa. Asia and Australia. In India only 3 species occur, all of which have been worked out indicating n = 16 or a basic number of 8. Morton concurs with our findings and populations of African *P. condensata* C. B. Cl. examined by him also reveal x=8. The homogenous morphological pattern in *Pollia* Thunb. and the appropriateness of merging both *Pollia* & *Aclisia* E. Meyer together under the former, is amply justified by available cytological data.

ANATOMY

In an excellent analysis, Tomlinson (1966) has analysed the role of anatomical data especially the leaf structure in the classification of Commelinaceae and our preliminary studies on Indian genera confirm that they are valuable as aids to taxonomy. Even in the vegetative state, *Murdannia* can be distinguished from *Aneilema* by hook and prickle hairs being absent (present in *Aneilema*), presence of uniseriate hairs (vs. absent), epidermal wall ridged (vs. smooth) presence of marginal fibres (vs. absent), adaxial hypodermis uniseriate throughout (vs. absent except in midrib region) and nature of glandular micro hairs. Both *Cyanotis* (*sensu lato*) and *Amischotolype* (=*Forrestia*) are characterised by 4-celled stomata but the presence of silica cells in the epidermis is a pointer to *Amischotolype.* There is however, no noticeable difference in the epidermal pattern of *Cyanotis* (*sensu stricto*), *Amischophacelus* and *Belosynapsis* though cytological and morphological evidences emphasise their distinct generic status.

PALYNOLOGY

A preliminary study reveals that pollen morphology is useful as a criteria for distinguishing the various genera and to some extent certain "species-complex" in *Commelina.* Further work is in progress.

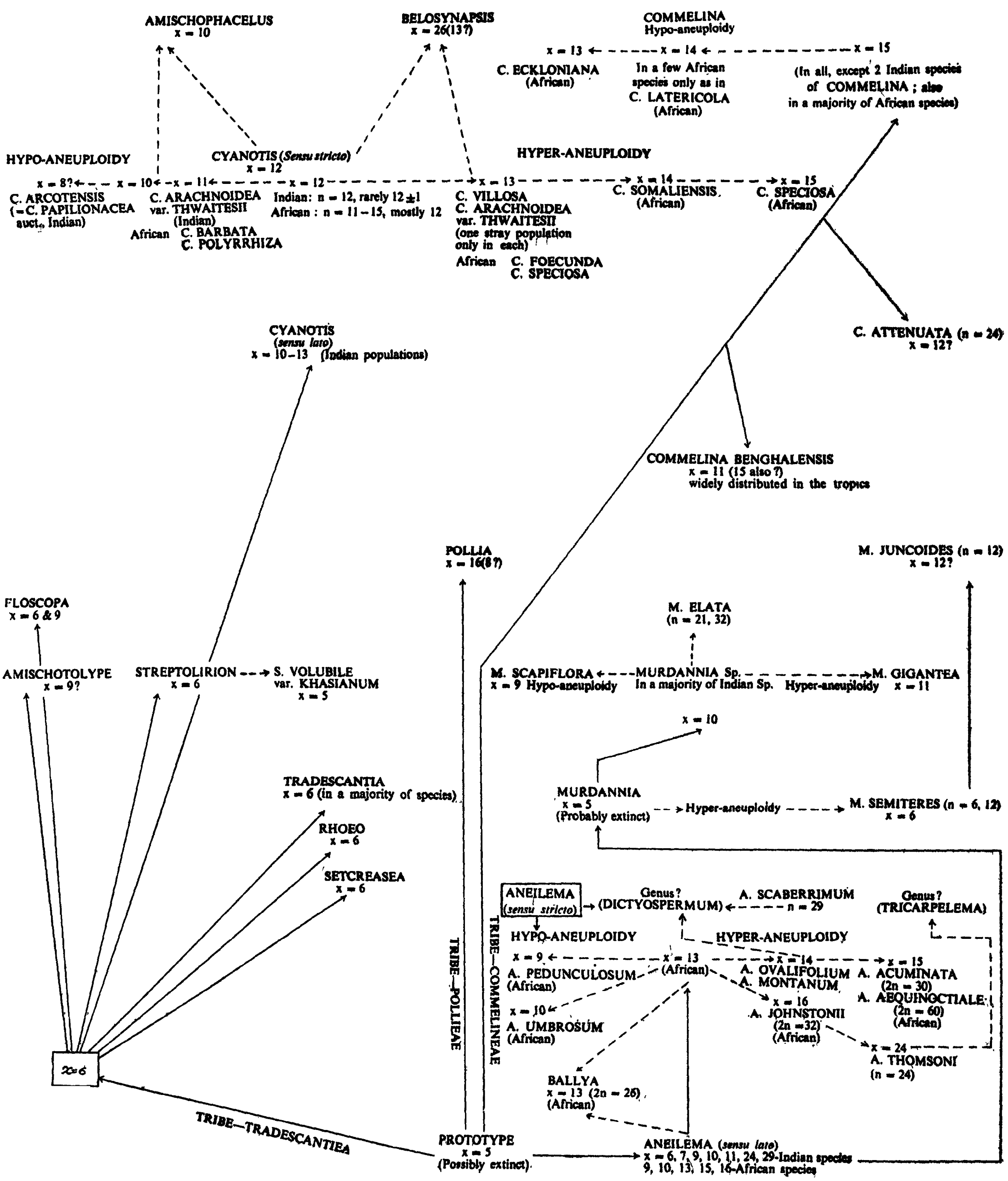
EVOLUTIONARY TRENDS

Summing up, in the tribe Commelineae, a basic number of x = 15 which is secondarily derived, is indicated for *Commelina* where polyploidy has played a major role in evolution and infra-specific aneuploidy is of minor significance. In this respect, it reveals a close similarity with *Murdannia* where a dominant line of x = 10 is indicated. In both the genera inter- and infra-specific polyploidy is far more common than infra-specific aneuploidy. Though the basic numbers differ *i.e.* x = 15 in *Commelina* and x = 10 in *Murdannia,* a prototype of x = 5 is suggested for both the genera. Such secondary basic numbers as x = 6, 9 and 11 indicated for few species of *Murdannia* might have been secondarily derived from x = 5, or x = 10. Cytological studies support the morphological data indicating the separation of *Murdannia* from *Aneilema,* the latter according to Morton being a heterogenous mixture of at least 3 genera. Preliminary cytological observations support Morton's redefining of *Aneilema* that the Indian species hitherto included under *Aneilema* are somewhat different from the African species of *Aneilema.* If we accept Morton's splitting up of *Aneilema,* into 3 genera, *Dictyospermum* with x = 7 (14) and *Tricarpelema* with x = 24 do not share the basic number reported for the African species of *Aneilema.* Though karyotype studies are yet to be undertaken, somatic and meiotic counts indicate that both *Dictyospermum* and *Tricarpelema* have very small chromosomes whereas the African species of *Aneilema* have larger chromosomes, thus further supporting Morton's observations.

The Tribe Tradescantieae is more or less characterised by a prototype of x = 6 (x = 9 & 12 being secondarily derived) in contrast to x = 5 in Commelineae. *Cyanotis* probably arose from a prototype with x = 6, and later, further differentiated from x = 12 stock through hyper- and hypo-aneuploidy, giving rise to such secondary basic numbers as x = 11, 13, 14 or 15, the latter number being much more widespread in Africa. Whereas infra-specific aneuploidy is widespread and a factor to be reckoned with in speciation and evolution in *Cyanotis,* inter- and infra-specific polyploidy are quite restricted. These secondary aneuploids by further structural differentiation and later stabilization in the course of evolution gave rise to distinct morphological varieties or species. *Belosynapsis* probably arose from such a *Cyanotis* stock with x = 13 and *Amischophacelus* probably was an extreme hypo-aneuploid derivative

PROBABLE EVOLUTIONARY TRENDS IN INDIAN GENERA OF COMMELINACEAE

(Based on the study of Indian species by the authors; other genera and species are incidentally included to explain the possible trend)



from a x=12 stock. *Floscopa* with a primary basic number of x=6 and a secondary number of x=9 is an off-shoot from the x=6 stock, and this aptly fits in Clarke's and Woodson's classification of including this genus under Tradescantieae rather than Bruckner's treatment under Commelineae. *Amischotolype* and *Streptolirion* also fit into the general pattern under Commelineae.

Recently Jones et al. (1969) have worked on *Tradescantia geniculata* Jacq., and *T karwinskyana* Roem. & Schult. which are somewhat different from the rest of the species of *Tradescantia* and report secondarily derived basic numbers as x=4 & x=5 respectively. It is interesting to note that Woodson (1942) advocates the inclusion of the above species under *Aneilema*, whereas Rohweder (1956) prefers their treatment under *Gibasis*. This confusion is understandable as *Tradescantia* in the broad sense is a mixture of many different genera. However, we cannot agree with Jones *et al.* that this is the lowest basic number recorded for any member of Commelinaceae so far. In India, *Streptolirion volubile* var. *khasiana* has a basic number of x=5, which in turn is secondarily derived from x=6.

The relation of *pollia* in tribe pollieae with other members in Commelineae and Tradescantieae is not well understood. This genus with an almost uniform basic number of x=8 stands apart from the other two tribes. Only *Pollia japonica* Thunb. (2n=38) and a population of *P. subumbellata* C. B. Cl. (2n=10) differ from this general pattern but both need a rechecking.

HABIT AND DISTRIBUTION

Generally polyploids as compared to diploids, are quite successful in invading and colonising new territories. Especially in Africa, polyploid races of *Commelina diffusa* Burm. f. and *C. benghalensis* Linn. are associated with hilly tracts whereas their diploid forms are confined to the plains. In India, however, due to lack of similar data, it is not possible, to correlate altitudinal distribution in relation to polyploidy within any given species. However, certain species such as *Commelina clavata* C. B. Cl. (n=45), *C. sikkimensis* C. B. Cl. (n=45), *C. indehiscens* Barnes (n=75) and *Cyanotis concanensis* Hassk. (n=36) are high polyploids which are confined only to hilly tracts but there is no record of corresponding diploid forms to facilitate comparison. In the case of *Commelina erecta* where, infraspecific polyploidy is widely prevalent, the populations are already high polyploids, being either hexaploids (n=45) or octaploids (n=60) and these occur from the plains to the hilly tracts irrespective of the degree of polyploidy. However, many species of *Commelina* have fully exploited the advantages of both in-breeding and out-breeding and this has been responsible for their success as weeds and for their pan-tropic nature. Further, the presence of cleistogamous flowers in some species and the capacity for vegetative propagation by cuttings have largely contributed to their adaptability even though the new gene combination may not be entirely advantageous to them. The close similarity between the diploids and polyploids especially in *Commelina* suggests auto-polyploidy and in Africa the multivalent configurations in the tetraploids and hexaploids only confirm this. However, allo-polyploidy is suggested in atleast a few species of *Murdannia* [as in *M. vaginata* (Linn.) Bruckn., *M. simplex* (Vahl) Brenen and *M. loriformis* (Hassk.) Rolla *et* Kam.] with markedly dissimilar bivalents and probably natural inter-generic hybridization is also involved. These are fertile fields for future genetic study.

Though many of the species are annuals, only a few have turned perennials with the development of underground bulbs as in *Cyanotis arachnoidea* C. B. Cl. var. *thwaitesii* Rolla *et* Kam., *C. vaga* (L.) Schult. f. and *Murdannia juncoides* (Wt.) Rolla *et* Kam. Interestingly enough, var. *thwaitesii* was found to be an aneuploid with n=11, and *Murdannia juncoides* a tetraploid. Morphological differentiation has been correlated with the change in genetic constitution.

The isolation mechanisms, be they genetic, geographical or ecological, have also contributed to the accumulation of differences, ultimately leading to taxonomic diversification. *Cyanotis adscendens* Dalz. (n=24) does not produce any viable seeds and propagation is purely vegetative by the trailing shoots rooting at the nodes. The studies revealed that it is possibly an auto-tetraploid form of *C. tuberosa* with irregular disturbed meiosis and as a result the pollen are sterile. However, this is now recognised as a distinct taxonomic species as the new gene-combination has been successfully retained by vegetative propagation accompanied by minor variations in taxonomic characters as well. *Cyanotis concanensis* Hassk. confined to the hill tops of the Sahyadris may be a case of geographic isolation. The plants are very robust exceeding a metre in height, have a patently villose pubescence and even at seedling stages, are distinguishable as a distinct species though their resemblance to *C. tuberosa* is quite striking. This species proved to be a hexaploid with n = 36 and possibly this fact coupled with their isolation to a limited higher altitude belt along the Sahyadris, has contributed to accumulation of differences and its recognition as a distinct species. Similarly it is possible that geographic and ecological isolation may account for *Cyanotis obtusa* Trimen, a distinct species from Peninsular India and Ceylon but restricted to the higher altitudes only and which resembles to some extent *C. arachnoidea* C. B. Cl. Though both the species are diploids with n = 12, the former thrives at an altitude of 1500 m or more where *C. arachnoidea* does not grow. Such cases appear to be interesting examples of geographically restricted parallelism (Went, 1971) needing further study. The genus *Amischotolype* (*Forrestia*) has been considerably confused due to its extreme variability and wide distribution from New Guinea and Malasia to the Eastern Himalayas. The recent collection of *A. mollissima* var. *glabrata* from the Eastern ghats forests (Tuni hills, Vishakapatnam dist., Andhra Pradesh) which forms a new record for the Peninsular India, indicates the possibility of locating it in Orissa forests and probably further south in hilly forests of Mysore and Madras State and further enhances the scope of study in the biosystematics of the genus. There are several such examples for more detailed study in the various genera of the family Commelinaceae and a proper biosystematic approach would solve such problems to a greater extent.

Taxonomy is an unending synthesis whose basis is becoming broadened decade after decade. It is, therefore, highly essential to bring about a coordinated synthesis between the "taxonomist" and the "biosystematist"—the former posing the various ambiguities wherever located in the understanding of taxa, while revising the families and preparing basic frame structure, and the latter working out such problems with the sophisticated techniques utilising the relevant data and material supplied by the taxonomist. Such coordination between the Government Scientific Institutions carrying out elaborate survey of species and the University Departments maintaining well-equipped Laboratories, would go a long way in solving several taxonomic problems of the Indian Flora.

LIST OF CHROMOSOME NUMBERS REPORTED IN INDIAN AND AFRICAN SPECIES OF COMMELINACEAE

Species No.	*Name of plant*	*n*	*2n*	*References*
Commelina Linn.				
SPECIES OCCURRING IN INDIA				
1.	*C. albescens* Hassk.	30	—	Lewis, H. W. & Taddesse, E. (1964; for Ethiopian races)
		15	—	Sundara Raghavan, R. cf. Rao Rolla, S., Kammathy, R. V. & Sundara Raghavan, R. (1968).
2.	*C. attenuata* Koen. ex Vahl	24	—	Kammathy, R. V. & Rao, Rolla S. (1961a)
3.	*C. benghalensis* Linn.	11	22	Ganguly, J. K. (1946); Sharma, A. K. (1955); Kammathy, R. V. & Rao, Rolla S. (1961a); Shetty, B. V. & Subramanyam, K. (1962); Panigrahi, G. & Kammathy, R. V. (1964)
		11+0–2B	—	Malik, C. P. (1961)
		11, 22	—	Lewis, H. W. (1964); Lewis, H. W. & Taddesse, E. (1964, for African populations)
		24*	—	Anderson, E. & Sax, K. (1936)
			28*, 56*	Morton, J. K. (1956)
			30	Harvey, M. J. (1966)
			c. 68*	Darlington, C. D. (1929)
4.	*C. clavata* C. B. Cl.	45	—	Kammathy, R. V. & Rao, Rolla S. (1961a); Sundara Raghavan, R. & Rao, Rolla S. (1965)
5.	*C. diffusa* Burm. f. (=*C. nudiflora* auct. non Linn.)	—	56*	Darlington C. D. (1929)
		—	30	Simmonds, N. W. (1954)
		15	30	Sharma, A. K. (1955); Kammathy, R. V. & Rao, Rolla S. (1961a).
		15	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Panigrahi, G. & Kammathy. R. V. (1964); Kammathy, R. V. & Rao, Rolla S. (1964); Lewis, H. W. (1964, African races); Lewis, H. W. & Taddesse, E. (1964, Ethiopian races)

*Numbers earlier recorded but found inconsistent as verified during the present investigations.

Species no.	*Name of Plant*	*n*	*2n*	*References*
	C. diffusa Burm. f. (contd.)	—	28*	Morton, J. K. (1956)
		—	35*, 42*	Sharma, A. K. (1955)
		—	28*, 56*	Sharma, A. K. & Sharma, A. (1958)
6.	*C. ensifolia* R. Br. (=*C. undulata* C. B. Cl. non R. Br.) var. *setosa* C. B. Cl.	45	—	Kammathy, R. V. & Rao, Rolla S. (1961a, 1964)
7.	*C. forskalaei* Vahl	—	28*	Morton, J. K. (1956)
		14*	—	Malik, C. P. (1961)
		15	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961a); Lewis, H. W. & Taddesse, E. (1964, for African races)
		15	30	Shetty, B. V. & Subramanyam, K. (1962)
8.	*C. hasskarlii* C. B. Cl.	45	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1964)
9.	*C. indehiscens* Barnes	75	—	Kammathy, R. V. & Rao, Rolla S. (1964)
10.	*C. imberbis* Ehrenb. ex Hassk. (=*C. jacobii* Fischer)	15	30	Kammathy, R. V. & Rao, Rolla S. (1961a) } Reported under *C. jacobii* for Peninsular India populations
		15	—	Shetty, B. V. & Subramanyam, K. (1962) } Reported under *C. jacobii* for Peninsular India populations
		15	—	Lewis, H. W. (1964, African population)
		30	—	Lewis, H. W. & Taddesse, E. (1964, for African races)
11.	*C. kotschyi* Hassk.	15	—	Kammathy, R. V. & Rao, Rolla S. (1964)
12.	*C. longifolia* Lamk.	—	75*	Sharma, A. K. (1955)
	(=*C. salicifolia* Roxb.)	45	—	Kammathy, R. V. & Rao, Rolla S. (1964)
13.	*C. maculata* Edgew. [=*C. paludosa* Bl. var. *viscida* (C. B. Cl.) Rao et Kammathy, *pro parte*]	15, 30	—	Panigrahi, G. & Kammathy, R. V. (1964, under *C. paludosa* var. *viscida*)
14.	*C. paleata* Hassk.	45	—	Kammathy, R. V. & Rao, Rolla S. (1961a, 1964)
15.	*C. paludosa* Bl. (=*C. obliqua* Buch.-Ham.)	—	100*, 150*	Sharma, A. K. (1955)
		—	45*	Sharma, A. K. & Sharma, A. (1958)
		30	60	Sharma, A. K. & Sharma, A. (1958)
		30	—	Kammathy, R. V. & Rao, Rolla S. (1961a, 1964); Panigrahi, G. & Kammathy, R. V. (1964)
16.	*C. sikkimensis* C. B. Cl.	30*	60*	Sharma, A. K. & Sharma, A. (1958)
		45	—	Panigrahi, G. & Kammathy, R. V. (1964); Kammathy, R. V. & Rao, Rolla S. (1964)
17.	*C. subulata* Roth	15	—	Lewis, H. W. & Taddesse, E. (1964, for African races)
		30	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961a)
18.	*C. suffruticosa* Bl.	30	—	Kammathy, R. V. & Rao, Rolla S. (1961a, 1964); Panigrahi, G. & Kammathy, R. V. (1964)
19.	*C. erecta* Linn. [=*C. undulata* R. Br.; *C. kurzii* C. B. Cl.; *C. paludosa* Bl. var. *mathewii* (C. B. Cl.) Rao, Rolla et Kammathy; *C. livingstonii* C. B. Cl.]	60	—	Malik, C. P. (1961, under *C. paludosa*); Sundara Raghavan, R. & Rao, Rolla S. (1961; under *C. paludosa*)
		45, 60	—	Kammathy, R. V. & Rao, Rolla S. (1961a, under *C. kurzii*)
		45	—	Kammathy, R. V. & Rao, Rolla S. (1964, under *C. kurzii*)
		—	56 †	Morton, J. K. (1956, for African races under *C. livingstonii*)
		30	—	Lewis, H. W. (1964, for African races under *C. livingstonii*)
NON-INDIAN SPECIES				
20.	*C. africana* Linn. var. *africana*	—	28†	Morton, J. K. (1956)
		15, 30, 60	—	Lewis, H. W. (1964)
		15	—	Lewis, H. W. & Taddesse, E. (1964)
21.	*C. africana* Linn. var. *krebsiana* C B. Cl.	—	28 †	Morton, J. K. (1956)
		—	30	Harvey, M. J. (1966)
22.	*C. ascendens* J. K. Morton	—	28†	Morton, J. K. (1956)
23.	*C. aspera* Benth.	—	28†	Morton, J. K. (1956)
24.	*C. aquatica* J. K. Morton	—	28 †	Morton, J. K. (1956)
25.	*C. capitata* Benth.	—	42†	Morton, J. K. (1956)
26.	*C. coelestis* Willd.	—	90	Darlington, C. D. (1929, for Mexican populations)
27	*C. congesta* C. B. Cl.	—	28 †	Morton, J. K. (1956)
28.	*C. eckloniana* Kunth	13, 13(+1?)	—	Lewis, H. W. (1964)
29.	*C. elgonensis* Bullock	30	—	Lewis, H. W. (1964)
30.	*C. gerrardi* C. B. Cl.	30	—	Lewis, H. W. (1964)
31.	*C. gerrardi* C. B. Cl. ssp. *maritima* J. K. Morton	—	56 †	Morton, J. K. (1956)

† Numbers mostly recorded for African species, needing however a critical re-investigation.

Species no.	*Name of Plant*	*n*	*2n*	*References*
32.	*C. hirtella* Vahl	—	c. 58	Bowden, (1940, for U. S. A. populations)
33.	*C. lagosensis* C. B. Cl.	—	28†	Morton, J. K. (1956)
34.	*C. lateriticola* A. Chev.	—	28	Harvey, M. J. (1966)
35.	*C. macrospatha* Gilg. & Lederm.	—	28†	Morton, J. K. (1956)
36.	*C. macrosperma* J. K. Morton	—	20†	Morton, J. K. (1956)
37.	*C. purpurea* C. B. Cl.	15	—	Lewis, H. W. (1964)
38.	*C. scaposa* C. B. Cl.	15	—	Lewis, H.W. (1964)
39.	*C. thomasii* Hutch.	—	56†	Morton, J. K. (1956)
40.	*C. umbellata* Thonn. var. *umbellata*	—	28†	Morton, J. K. (1956)
41.	*C. umbellata* Thonn. var. *gambiae* C. B. Cl.	—	28†	Morton, J. K. (1956)
42.	*C. virginica* Linn.	—	c. 52	Simmonds, N. W. (1954)
43.	*C. welwitschii* C. B. Cl.	30	—	Lewis, H. W. (1964)

In addition, Lewis, H. W. (1964) has also reported meiotic counts of n=14, 15, 28, 30 and 45 for a few African species which have not yet been properly identified. Except for *C. coelestis* and *C. hirtella*, most of the non-Indian species listed above are African in distribution.

Cyanotis D. Don (sensu lato)

SPECIES OCCURRING IN INDIA

Species no.	*Name of Plant*	*n*	*2n*	*References*
Amischophacelus Rolla Rao et Kammathy				
1.	*A. axillaris* (Linn.) Rolla Rao et Kammathy [=*Cyanotis axillaris* (Linn.) Schult. f.]	10	—	Murthy, K. L. (1934); Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961b)
		10	20	Islam, A. S. & Baten, A. (1952); Sharma A. K. (1955); Shetty, B. V. & Subramanyam, K. (1962)
2.	*A. cucullata* (Roth) Rolla Rao et Kammathy [=*Cyanotis cucullata* (Roth) Kunth]	10	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961b)
Belosynapsis Hassk.				
1.	*B. kewensis* Hassk.	26	—	Sundara Raghavan, R. & Rao, Rolla S. (1965)
2.	*B. vivipara* (Dalz.) Fischer	26	—	Sundara Raghavan, R. & Rao, Rolla S. (1965)
Cyanotis D. Don (Sensu stricto)				
1.	*C. adscendens* Dalz. [=*C. tuberosa* (Roxb.) Schult. var. *adscendens* (Dalz.) C. B. Cl.; *C. sarmentosa* Wt.]	24	—	Sundara Raghavan, R. & Rao, Rolla S. (1961, under var. *adscendens*); Kammathy R. V. & Rao, Rolla S. (1961b) (under *C. tuberosa*, Gajanoor population)
2.	*C. arachnoidea* C. B. Cl. var. *arachnoidea*	12	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
		12	24	Shetty, B. V. & Subramanyum, K. (1962)
3.	*C. arachnoidea* C. B. Cl. var. *thwaitesii* Rolla Rao et Kammathy	11	—	Kammathy, R. V. & Rao, Rolla S. (1961b, under *C. arachnoidea*, bulbiferous form)
		11, 13	—	Sundara Raghavan R. & Rao, Rolla S. (1965)
4.	*C. arcotensis* Rolla Rao (=*C. papilionacea* auct., *pro parte*)	8	—	Shetty, B. V. & Subramanyam, K. [1962, under *C. papilionacea* (Linn.) R. & S.]
		12	—	Sundara Raghavan, R. & Rao, Rolla S. (1965)
5.	*C. burmanniana* Wt.	12	—	Kammathy, R. V. & Rao, Rolla S. (1964)
6.	*C. cerifolia* Rolla Rao et Kammathy	12	—	Kammathy, R. V. & Rao, Rolla S. (1964); Sundara Raghavan, R. & Rao, Rolla S. (1965)
7.	*C. concanensis* Hassk. (=*C. sahyadrica* Blatter; *C. stocksii* Hassk.)	36	—	Sundara Raghavan, R. & Rao, Rolla S. (1961, under *C. tuberosa* R. & S.); Kammathy, R.V. & Rao, Rolla S. (1961b, under *C. tuberosa*; 1964, under *C. sahyadrica*)
8.	*C. cristata* (Linn.) Don	12	24+0−1B	Islam, A. S. & Bataen, A. (1952)
		12	24	Sharma, A. K. (1955); Shetty, B. V. & Subramanyam, K. (1962)
		12	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961b)
9.	*C. fasciculata* (Heyne ex Roth) Schult. f. var. *fasciculata*	12	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Shetty, B. V. & Subramanyam, K. (1962); Kammathy, R. V. & Rao Rolla S. (1964)
10.	*C. fasciculata* (Heyne ex Roth) Schult. f. var. *glabrescens* C. B. Cl.	12	—	Kammathy, R. V. & Rao, Rolla S. (1964)
11.	*C. obtusa* Trimen	12	—	Kammathy, R. V. & Rao, Rolla S. (1961b, under *C. arachnoidea* Herb. Sheet BSI 73296)
12.	*C. pilosa* Schult. f.	12	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
13.	*C. tuberosa* (Roxb.) Schult. f.	12	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Kammathy, R. V. & Rao, Rolla S. (1961b); Shetty, B. V. & Subramanyam, K. (1962)
14.	*C. vaga* (Lour.) Schult. f. (=*C. barbata* Don)	12	—	Sharma, A. K. & Sharma, A. (1958); Kammathy, R. V. & Rao, Rolla S. (1964)
		11*	—	Lewis, H. W. (1964, for Kenya races); Lewis, H. W. & Taddesse, E. (1964, for Ethiopian races)

Species no.	*Name of Plant*	*n*	*2n*	*References*
15.	*C. villosa* Schult. f.	12	24	Shetty, B. V. & Subramanyam, K. (1962)
		13	—	Sundara Raghavan, R. & Rao, Rolla S. (1965)
16.	*C. wightii* C. B. Cl.	12	—	Kammathy, R. V. & Rao Rolla S. Cf. Rolla, S. R., Kammathy, R. V. & Sundar Raghavan, R. (1968)
AFRICAN SPECIES				
17.	*C. foecunda* Hassk.	13	—	Lewis, H. W. (1964)
18.	*C. lanata* Benth.	12	—	Lewis, H. W. & Taddesse, E. (1964)
		—	24	Harvey, M. J. (1966)
19.	*C. longifolia* Benth.	12	—	Lewis, H. W. (1964)
20.	*C. polyrrhiza* Hassk.	11	—	Lewis, H. W. & Taddesse, E. (1964)
21.	*C. somaliensis* C. B. Cl.	—	28†	Darlington, C. D. (1929)
22.	*C. speciosa* (Linn. f.) Hassk.	13, 13+1 and 15	—	Lewis, H. W. (1964)
Aneilema R. Br.				
SPECIES OCCURRING IN INDIA				
1.	*A. montanum* Wt.	14	—	Kammathy, R. V, & Rao, Rolla S. (1961b); Shetty, B. V. & Subramanyam, K. (1962)
2.	*A. ovalifolium* (Wt.) C. B. Cl.	14	—	Kammathy, R. V. & Rao, Rolla S. (1964)
3.	*A scaberrimum* (Bl.) Kunth (=*A. protensum* Wall. ex C. B. Cl.)	59*	—	Panigrahi, G. & Kammathy, R. V. (1963)
		29	—	Kammathy, R. V. & Rao, Rolla S. (1964)
4.	*A. thomsoni* C. B. Cl.	c. 24	—	Panigrahi, G. & Kammathy, R. V. (1963 under '*A. aequinoctiale* Kunth')
EXCLUSIVELY AFRICAN SPECIES				
1.	*A. acuminata* R. Br. (*A. papuanum* Warb.)	—	30	Morton, J. K. (1966)
2.	*A. aequinoctiale* Kunth	30	—	Lewis, H. W. (1964)
		—	60	Morton, J. K. (1966)
3.	*A. beniniense* Kunth	—	52	Morton, J. K. (1966)
4.	*A. beniniense* Kunth subsp. *beniniense*	—	52	Morton, J. K. (1966)
5.	*A. beniniensi* Kunth subsp. *sessilifolium* (Benth.) J. K. M.	—	52	Morton, J. K. (1966)
6.	*A. dispermum* Brenan	—	26	Morton, J. K. (1966)
7.	*A. johnstonii* K. Sch.	16	—	Lewis, H. W. (1964)
8.	*A. lanceolatum* Benth. subsp. *lanceolatum*	—	26, 52	Morton, J. K. (1966)
9.	*A. lanceolatum* Benth. subsp. *subnudum* (A. Chev.) J. K. M.	—	26	Morton, J. K. (1966)
10.	*A. paludosum* A. Chev. subsp. *paludosum*	13	26	Morton, J. K. (1966)
11.	*A. paludosum* A. Chev. subsp. *pauciflorum* J. K. M.	13	26	Morton, J. K. (1966)
12.	*A. paludosum* A. Chev. subsp. *pseudolanceolatum* J. K. M.	—	26	Morton, J. K. (1966)
13.	*A. pomeridianum* Stanfield & Brenan	—	26	Morton, J. K. (1966)
14.	*A. setiferum* A. Chev. var. *pallidociliatum* J. K. M.	—	52	Morton, J. K. (1966)
15.	*A. taccazeanum* Hochst.	13	—	Lewis, H. W. (1964)
16.	*A. umbrosum* Kunth subsp. *umbrosum*	—	40	Morton, J. K. (1966)
17.	*A. umbrosum* Kunth subsp.	—	24	Harvey, M. J. (1966)
	ovato-oblongum (Beauv.) J. K. M.	—	20	Morton, J. K. (1966)
18.	*A. umbrosum* subsp. *umbrosum* × subsp. *ovato-oblongum*	—	24, 25, 26, 30	Morton, J. K. (1966)
19.	*A. welwitschii* C. B. Cl.	26+1	—	Lewis, H. W. (1964)
20.	*A. sp. aff. pedunculosum* C. B. Cl.	9	—	Lewis, H. W. (1964)
Murdannia Royle				
SPECIES OCCURRING IN INDIA				
1.	*M. dimorpha* (Dalz.) Bruckn.	10	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
2.	*M. divergens* (C. B. Cl.) Bruckn.	30	—	Panigrahi, G. & Kammathy, R. V. (1963)
3.	*M. elata* (Vahl) Bruckn. (=*Aneilema herbaceum* Wall.)	—	40*	Sharma, A. K. & Sharma, A. (1958)
		32	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
		21	42	Panigrahi, G. & Kammathy, R. V. (1963)
4.	*M. esculenta* (Wall. ex C. B. Cl.) Rolla Rao et Kammathy	10	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
5.	*M. gigantea* (Vahl) Bruckn.	11	—	Panigrahi, G. & Kammathy, R. V. (1963)
		22	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
6.	*M. hookeri* (C. B. Cl.) Bruckn.	10	—	Kammathy, R. V. & Rao, Rolla S. (1964)
7.	*M. juncoides* (Wt.) Rolla Rao et Kammathy	12	—	Kammathy, R. V. & Rao, Rolla S. (1964)

Species no.	Name of Plant	n	2n	References
8.	*M. loriformis* (Hassk.) Rolla Rao et Kammathy [=*Aneilema nudiiflorum* R. Br. var. *terminale* (Wt.) C. B. Cl.]	20	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
		20	40	Shetty, B. V. & Subramanyam, K. (1962, under '*M. sinicum*')
		—	39*	Panigrahi, G. & Kammathy, R. V. (1963, under '*M. nudiflora* var. *terminalis*')
9.	*M. nudiflora* (Linn.) Brenan	10	—	Simmonds, N. W. (1954); Kammathy, R. V. & Rao, Rolla S. (1961b), Panigrahi, G. & Kammathy, R. V. (1963).
		10	20	Sharma, A. K. (1955)
10.	*M. ochracea* (Dalz.) Bruckn.	18, 30	—	Sundara Raghavan, R. & Rao, Rolla S. (1961)
11.	*M. scapiflora* (Roxb.) Royle	9	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
12.	*M. semiteres* (Dalz.) Santapau	7*, 10*, 20*	—	Sundara Raghavan, R. & Rao, Rolla S. (1961)
		12	—	Kammathy, R. V. & Rao, Rolla S. (1961b)
		6	—	Kammathy, R. V. & Rao, Rolla S. (1964)
13.	*M. simplex* (Vahl) Brenan	20	—	Lewis, H. W. (1964, for African races)
		30	—	Sundara Raghavan, R. & Rao, Rolla S. (1961); Malik, C. P. (1961, under *M. nudiflora*); Kammathy, R. V. & Rao, Rolla S. (1961b)
		40	—	Panigrahi, G. & Kammathy, R. V. (1963)
		—	40	Morton, J. K. (1966, for African races)
14.	*M. spirata* (Linn.) Bruckn.	20	—	Murthy, K. L. (1934); Panigrahi, G. & Kammathy, R. V. (1963); Kammathy, R. V. & Rao, Rolla S. (1961b)
		9*	—	Sundara Raghavan, R. & Rao, Rolla S. (1961).
		—	20*	Sharma, A. K. & Sharma, A. (1958)
15.	*M. triquetra* (Wall. ex C. B. Cl.) Bruckn.	—	40	Panigrahi, G. & Kammathy, R. V. (1963)
16.	*M. vaginata* (Linn.) Bruckn. (=*Aneilemavaginatum* R. Br.)	—	40	Sharma, A. K. & Sharma, A. (1958)
		20	—	Kammathy, R. V. & Rao, Rolla S. (1964)
17.	*M. wightii* Rolla Rao et Kammathy [=*M. pauciflora* (Wt.) Bruckn.]	10	—	Sundara Raghavan, R. & Rao, Rolla S. (1961)
		9	—	Kammathy, R. V. & Rao Rolla, S. (1964)
	NON-INDIAN SPECIES			
18.	*M. keisak* (Hassk.) Hand.-Mazz. (=*Aneilema keisak* Hassk.)	—	30	Mitsukuri, Y. (1947)
19.	*M. tenuissima* (A. Chev.) Brenan	—	40	Morton, J. K. (1966)
Pollia Thunb.				
	SPECIES OCCURRING IN INDIA			
1.	*P. hasskerlii* Rolla Rao (=*P. aclisia* Hassk.)	16	—	Kammathy, R. V. & Rao, Rolla S. (1964)
2.	*P. secundiflora* (Bl.) Backer [=*P. sorzogonensis* (Miq.) Mey.]	16	—	Kammathy, R. V. & Rao, Rolla S. (1964)
3.	*P. subumbellata* C. B. Cl.	—	10*	Darlington, C. D. & Wylie, A. P. Chromosome Atlas of Flowering Plants (1955)
		16	—	Kammathy, R. V. & Rao, Rolla S. (1964)
	NON-INDIAN SPECIES			
4.	*P. condensata* C. B. Cl.	—	32	Mangenot, S. & Mangenot, G. (1960)
5.	*P. japonica* Thunb.	—	38	Mitsukuri (1947)
Streptolirion Edgew.				
1.	*S. volubile* Edgew. var. *volubile*	—	12 (occasionally 11 also in some cells)	Sharma, A. K. & Sharma, A. (1958)
		6	—	Kammathy, R. V. & Rao, Rolla S. (1964)
2.	*S. volubile* Edgew. var. *khasiana* C. B. Cl.	5	10	Panigrahi, G. & Kammathy, R. V. cf. Rolla, S. R., Kammathy, R. V. & Sundara Raghava, R. (1968)
Floscopa Lour.				
1.	*F. scandens* Lour.	12	—	Kammathy, R. V. & Rao, Rolla S. (1961a)
Amischotolype Hassk. (=*Forrestia* Less et A. Rich.)				
1.	*A. mollissima* Hassk. var. *marginata* (Bl.) Rolla Rao (=*Forrestia marginata* Hassk.)	—	c. 36	Kammathy, R. V. cf. Rolla, S. R., Kammathy, R. V. & Sundara Raghava, R. (1968)
Ballya Brenan				
1.	*B. zebrina* (Chiov.) Brenan (=*Aneilema zebrina* Chiov.)	—	26	Jones (unpub.), quoted from Kew Bull. 19 : 64 (1964)

ACKNOWLEDGEMENT

The authors wish to express their thanks to the Director, Botanical Survey of India, Calcutta for facilities provided for the preparation of this paper.

REFERENCES

ANDERSON, E. AND K. SAX. A cytological monograph of the American species of *Tradescantia*. *Bot. Gaz.* 97: 433-476, 1936.

BRENAN, J. P. M. The classification of Commelinaceae, *J. Linn. Soc.* (*Bot.*) 59:349-70, 1966.

BRÜCKNER, G. Commelinaceae, in *Die naturlichen Pflanzenfamilien* (A. Engler & K. Prantl), 2nd edition, 15a: 159-181, Leipzig, 1930.

CLARKE, C. B. Commelinaceae, in DC. *Mon. Phan.* 3: 113-324, 1881.

HARVEY, M. J. IOPB Chromosome number Reports VII, compiled by A. Love. *Taxon* 15: 155-156, 1966.

HOOKER, J. D. Commelinaceae, in *Fl. Brit. India*, 6: 366-390. England, 1892.

HUTCHINSON, J. (*Families of Flowering plants—Monocotyledons*). 2nd edition, 2: 561-566, Oxford University Press, 1959.

JONES, KEITH ET AL. Contributions to the cytotaxonomy of the Commelinaceae I—*Tradescantia geniculata* and its allies. *J. Linn. Soc. Lond.* (*Bot.*) 62: 206-221, 1969.

JOSEPH, J. AND SESHAGIRI RAO ROLLA. *Aneilema glanduliferum* Joseph *et* Rolla Rao—a new species from N.E.F.A. *J. Indian bot. Soc.* 47: 367-371, 1968.

KAMMATHY, R. V. AND SESHAGIRI RAO ROLLA. Notes on Indian Commelinaceae-II. Cytological observations. *Bull. bot. Surv. India* 3: 167-169, 1961a.

—— AND ——. Notes on Indian Commelinaceae-III. Cytological observations. *Ibid.* 3: 393-394, 1961b.

—— AND ——. Notes on Indian Commelinaceae-IV. Cytotaxonomic observations. *Ibid.* 6: 1-6, 1964.

LEWIS, W. H. ET AL. Chromosome numbers in some angiosperms of the southern United States and Mexico. *Rhodora* 64: 147-161, 1962.

——Meiotic chromosomes in African Commelinaceae. *Sida* 1: 274-293, 1964.

—— AND E. TADDESSE. Chromosome numbers in Ethiopian Commelinaceae. *Kirkia* 4: 213-215, 1964.

MANGENOT, S. AND G. MANGENOT. *Index to Plant chromosome numbers for* 1959. University of North Carolina, 1960.

MORTON, J. K. A revision of the genus *Aneilema* R. Brown (Commelinaceae) with a cytotaxonomic account of the West African species. *J. Linn. Soc. Lond.* (*Bot.*) 59: 431-478, 1966.

——The Commelinaceae of West Africa: a biosystematic survey. *J. Linn. Soc. Lond.* (*Bot.*) 60: 167-221, 1967.

PANIGRAHI, G. AND R. V. KAMMATHY. Cytogenetical evolution in *Aneilema sensu lato* in Eastern India. *Mem. Indian bot. Soc.* 4: 90-98, 1961.

—— AND ——. Studies on the taxonomy and cytology of certain species of *Aneilema sensu lato* in Eastern India. *Proc. nat. Acad. Sci. India.* 33: 491-506, 1963.

—— AND ——. Cytotaxonomic studies in certain species of *Commelina* L. in Eastern India. *J. Indian bot. Soc.* 43: 294-310, 1964.

PANUNGANTI, N. RAO. Meiotic studies in *Cyanotis villosa* Schult. *Nucleus* 13: 106-110, 1971.

ROHWEDER, O. Die Farinosae in der vegetation von El Salvador. *Abh. Geb. Auslandsk.* 61 (C, 18), 1956.

ROLLA, SESHAGIRI RAO. Indian species of Commelinaceae-Miscellaneous Notes. *Notes R. bot. Gdn. Edinburgh* 25: 179-189, 1964.

——*Commelina undulata*. *Notes R. bot. Gdn. Edinburgh* 26: 351-352, 1966.

——Indian species of Commelinaceae—Miscellaneous Notes II. *Blumea* 14: 345-354, 1966.

——Notes on Indian Commelinaceae—nomenclature and distribution. *M. V. M. Patrika* 6: 52-55, 1971.

—— AND R. V. KAMMATHY. Notes on Indian Commelinaceae-I. *J. Bomb. nat. Hist. Soc.* 59: 58-70, 1962.

—— AND ——. Notes on Indian Commelinaceae-V. *J. Linn. Soc. Lond.* (*Bot.*) 59: 305-308, 1966.

——, —— AND R. SUNDARA RAGHAVAN. Cytotaxonomic studies on Indian Commelinaceae—A review. *J. Linn. Soc. Lond.* (*Bot.*) 60: 357-380, 1968.

ROWLEY, J. R. The fine structure of the pollen wall in the Commelinaceae. *Grama Palynol.* 2: 3-31, 1959.

SHARMA, A. K. Cytology of some of the members of Commelinaceae and its bearing on the interpretation of phylogeny. *Genetica* 27: 323-363, 1955.

—— AND A. SHARMA. Further investigations on cytology of members of Commelinaceae with special reference to the role of polyploidy and the origin of ecotypes. *J. Genet.* 56: 1-22, 1958.

SHETTY, B. V. AND K. SUBRAMANYAM. Cytological studies in Commelinaceae. *Nucleus* 5: 39-50, 1962.

SUNDARA RAGHAVAN, R. AND ROLLA S. RAO. Cytological observations on the Indian species of Commelinaceae. *Curr. Sci.* 30: 310-311, 1961.

—— AND ——. Notes on Indian Commelinaceae VI—Cytological Observations. *Nucleus* 8: 39-44, 1965.

TOMLINSON, P. B. Anatomical data in the classification of Commelinaceae. *J. Linn. Soc. Lond.* (*Bot.*) 59: 371-395, 1966.

WENT, F. W. Parallel evolution. *Taxon* 20: 197-226, 1971.

WOODSON, R. E. Commentary on the North American Genera of Commelinaceae *Ann. Mo. bot. Gdn.* 29: 141-154, 1942.