# Results and Discussion

## DISCUSSION :

Genus **Cyanotis** D.Don., wide spread through out the world, but most abundant in tropical and subtropical regions of Africa and Asia. In India it is represented by about 16 species (Hooker (1897). Fischer (1928) recorded 9 species of the genus from Madras presidency, while Cooke (1907) reported 7 species to be occuring in the Bombay presidency. Although the genus **Cyanotis** is of little economic inportance, it is interesting from Botanical point of view in understanding evolution and diversification of Commelinaceae in general and **Cyanotis** in particular. The critical studied on morphology and cytology of **Cyanotis** species growing in Maharashtra especially in Western Maharashtra, have revealed some important results whice are discussed below.

## MORPHOLOGY :

J.D.Hooker (1897) reported 16 species of the genus **Cyanotis** from British India. Karthikeyan and Jain (1989) have reported 16 species and about 6 varities in the country. at present the species occuring in India are mainly distributed in peninsular India and South Western India.

Most of the Indian species are found in Maharashtra. Cooke (1907) In his flora of presidency of Bombay reported 7 species of genus **Cyanotis** namely **C.papilionacea**, **C.tuberosa**, **C.fasciculata**, **C.cristata**, **C.wightii**, **C.vivipara**, **C.axillaris** and the species are mostly ristricted to South Western Maharashtra especially Sahyadri ranges.

Family commelinaceae affords an excellent group for study of variation and speciation, especially in a tropical country. Morphological evidences on the three sections of the Genus **Cyanotis** D.Don. (Sensu lato) shows unnatural assemblage. Species of **Cyanotis** (sensu stricto) normally shows n=12. Amongest the seven taxa studied in the present investigation **Amischophaselus Cucullata** (C.cucullata) having n=10 was formerly reported to be distributed from Canara to Malbar in South India, also differs morphologically from **Cyanotis** species. The species is most common member of marshy vegetation of Kolhapur district, and part of Sangli district viz. Kadegaon, Kadepur. It grows luxuriently on the clay moist soils during mansoon. Rolla and Kammathy (1962) reported its occurence in Poona district. This species is closely related to **A.axillaris** in its morphological features but differs in fruit with three projections. In **A.cucullata** projections are present which absent in **A.axillaris.**

During the revision of flora of Bombay presidency Blatter (1928) described new species **Cyanotis Sahyadrica** from **Cyanotis tuberosa**, **Cyanotis Sahyadrica** grows at high altitudes of 1000-1500 meter, having high rainful and is districted only at western ghats and now named under **Cyanotis Concanensis** by Rolla Rao (1966).

**Cyanotis fasciculata** normaly observed in all over western Maharashtra, but abundantly growing mostly along some what high altitude in western ghats in Kolhapur region, It also grows abundantly at Panhala and certain places of Sangli District.

**Cyanotis cristata** is mainly occurs in shady places on the house walls in rainy seasons where there is high amount of calcium.

It is evident from table and figures, that **Cyanotis tuberosa** varies greatly in its morphology and cytological attributes. According to its ecogeographical conditions, three distinct forms are obseved in present investigation viz. **C.tuberosa** (2n=24), **C.tuberosa** var. adsendens (2n=24) and **Cyanotis tuberosa** robust (2n=48). Raghavan and Rolla (1961) reported **C.tuberosa** var. adscendens with 2n=48, however in present investigation robust variety is of tetraploid nature and not abundens.

From the foregoing account it can be concluded that taxa under study are showing separate entities and **C.tuberosa** is in an active evolution any phase.

CYTOLOGY :

Chromosome numbers reported in present investigation of **Amischophaselus Cucullata, Cyanotis Concanensis, Cyanotis Cristata,** and **Cyanotis tuberosa**, and its morphs agree with previous reports made by Raghavan, Rolla Rao, and kammathy (1961-1968).

However karyotypic details of **A.cucullata, C.concanensis, C.cristata** and **C.tuberosa** (Robust) form have been reported first time. It is evident from table 4 to 11 and fig. II A.F. . That karyotypes of **A.cucullata** and **Cyanotis** species under study are representing specific differentiation . karyotypes in all the taxa studied are of asymmetrical in nature and indicating advanced nature of the taxa. Differences in absolute chromosome size reflects different amount of genus duplication either in tandom fusion or through polytene multiplication of chromonemata. And also that species having greater chromatin length, well supposed to be primitive where as species with lesser chromatin length were treated as advanced (stebbins) (1971). It is evient from table 4 to 11 that haploid chromatin length is minimum in **A.cucullata** followed by **C.tubrosa** var. adsendens, **C.tuberosa**, **C.cristata**, **C.tuberosa** (robust form) and **C.concanensis.** A wide range of haploid chromatin length is observed in species under study (35.45 - 125.7), and this implies that polyploidy effect is responsible for process of speciation, similarly wide range of TCL %, higher TF % and S % ~~are~~ also indicate that ploidy is responsible for speciation. Genera **Amischophacelus** and **Cyanotis** together with **Belosyhapsis** were previously included as three well defined sections of the genus **Cyanotis** D.Don. They were separated on morphological grounds by sprague and Fischer (1928), Rao and Kammathy (1968), cytologically it is fully justified by sharma (1955) and Rao et.al. (1968) and a separate generic status is alloted to **C.axillaris** as **Amischophacelus axillaris.** The present observations also indicate that the chromosome number (n=10) and karyotype with specific differences in **A.cucullata,** (**C.cucullata**) differs significantly from the other species of **Cyanotis** studied.

These three genera have been included on morphological grounds in most classification within the group Tradescantieae. There fore on the basis of chromosome morphology, as observed in present investigation and previous reports ressembling the **Commelina** line and number indicative of the **Tradescantia** line, these three genera possibly indicate the relation ships between these two lines. Taking these factors in to account their inclusion as a distinct tribe Cyanoteae (pichon i.e.) on group VI of Brenan (l.c.) Separate from Tradescantieae from Commelinieae appears to be more justified.

The population of **A.cucullata** studied here has certain karyotype morphological differences to that of population studied by Bhattacharya (1975). The discrepancies in the karyotype of this species as observed by present and previous authors, may be accounted for on the basis of irregular chromosome behavior, giving rise to structural changes of chromosome as observed during the meiotic as well as to some extent in the somatic behavior of the species.

It is evident from table 4 to 11 that alternation in karyotype of **Cyanotis** at interspecific level is a clear index in structural changes inchromosomes . In the process of evolution of a species . Cytologically the members of this family have formed ideal materials for the study of various aspects including different types of chromosome behavior. **Tradescantia** and **Rhoeo** are perhaps the most thoroughly explored genera in this connection.

An analysis of relative chromosome size is vital to the understanding of cytological affinities between various forms and species of a genus and various genera of the family. It is clear from table No.11 that there are significant differences in relative length of chromosome of **A.cucullata** and three species of **Cyanotis** under study. In **A.cucullata** the relative length of the chromosome ranges in between 0.61-1 while in other species of **Cyanotis** under study, the wider range has been observed. It is interesting to note that in **C.tuberosa** (2n=24) the relative length of the chromosome is of different magnitude at variety level too.

In Robust form of **C.tuberosa** (2n=48) a simple duplication of a genome is observed which implies autopolyploide nature of the taxa. However it is difficult to attribute its origin to **C.tuberosa** (2n=24) and **C.tuberosa** var. adsendens. Similar situation is observed in **C.concanensis** (2n=72) "Polyploidy", through which immediate genetical isolation can be attained in some cases, has occured in many occassions in the Commelinaceae, several of these intraspecific polyploidy may be of autopolyploid origin like the cccurence of 2n=28 and 56 in **Commelina diffusa** and 2n=45, 60, 100 and 150 in **Commelina paludosa** (Sharma (1958).) Absence of large number of multivalents though possibly due to the short size of chromosomes may also result from structural alternations accompaining polyploidy. Though sharma and sharma (1958) tentatively suggested that autopolyploidy alone can not account for speciation yet morton (1966) indicates complete isolating effect of polyploidy in certain cases.

The isolation mechanism, be they genetic, geographical or ecological have also contrubuted to the accumulation of differences, ultimately leading to taxonomic diversification. Kammathy and Rao Rolla (1961) have observed that have **Cyanotis tuberosa** var.

adsenens (n=24) propagation is purely vegetative by the trailing shoots, rooting at the node. The studies revealed that it is possibly an auto tetraploid form of **C.tuberosa** with or regular distributed 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 successful, retained by vegetative propagation accompanied by minor variations in the taxonomic characters as well as **Cyanotis concanensis** confined to the hill tops of Sahyadris may be a case of geographical isolation. Its ressemblance to **C.tuberosa** (n=12) is quite striking. It is 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. Similar is the case of **C.obtusa** a distinct species from peninsular India and ceylon but restricted to the higher altitude only. Suce cases appear to be interesting examples of geographically restricted parallelism (Went (1971)). There are several such examples for more detailed study in the various genera of the family Commelinaceae and a proper biosystematic approach would such problem to a greator extent.

The role of alternations in the chromosome structure in speciation is well known. A major factor in the maintenance of structural and numerical alternations in different populations of this family is the fact that, most of the tropical members are propagated either partialy or some times wholly through vegetative means. The entrance of variant nucleus in to the growing apex of an asexually reproducing plant may give rise to a new form leading to the formation under favourable circumstance of a new taxon.

In general meiosis was found normal in most of the present investigatied diploid taxa, of whole polyploids are having meiotic observations resulting in reduced pollen fertility. It is also interesting to note that all these taxa have capacity to reproduce by vegetative means, and thus structural changes are perpectuated from generation to generation.

Present observations of chromosomal confugrations ranging from all bivalents a variable mixture of bivalents and multivalents are indicative of partial chromosomal homologies in the studied populations of **C.concanensis** (n=36) and populations of **C.tuberosa** (n=24) in (plate IV ± VI and fig.)

Chromatin brigdes and leggards as seen in few pollen mother cells may be due to crossing over in the inverted segements and or non disjunctional orientation. Formation of multiple rings and chain configurations may be attributed to segmental interchanges and or complete homologies of the genomes. It is evident in many taxa that the difficiency of even one chromosome or its segment can be lethal at the diploid level where as higher ploidy level such losses can be tolerated. It is clear from present investigation that, polyploids though meiotically unstable adopted the vegetative means of reproduction with further evolution by segmental interchanges.

It is apparent from the cytological studies on this genus, made earlier and have that is has basic number 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.somotiensis**, C.B.Cl. (X=14) and **C.speciosa** (Linn.F.) Hassk (X=13,15). In India of the 15 species that occure a basic number of X=12 has been recorded for all the species without exception. Interspecific polyploidy is confined only to **C.concanensis**, Hassk. (n=36) and **C.tuberosa** and **C.tuberosa** var.adsendens (n=24) only. Intraspecific polyploidy could be observed only in **C.tuberosa** (n=12,24). A few populations of **C.arachinoidea** and var. thwattessii (n=12,12,13) and **C.villosa** (n=12,13) reveal an evolution any frend towards intraspecific aneuploidy which however is wide spread and of greater frequency in Africa (Rao etal. 1970). In **C.villosa** occurence of n=12 and 13 is recorded by panuganti (1971) and postulated that the first instance followed by structural differentiation.

The genus **Cyanotis** which combine the basic number of Tradescantieae (X=12) with chromosome structure of commainaceae separate examplify the relationships and the interbreeding between these two major lines which has resulted in the other subfamilies. Further expermentation of hybridization in genus **Cyanotis** and its allies will help to understand the relationship to a greater extent.