# Summary & Conclusions

Cooke (1907) in his 'Flora of Bombay Precidency' reported 3 species of Dipcadi viz. D. concanense, D.montanum and D. minor from Maharashtra State. During revesion of flora of Bombay precidency, Blatter and MeCann (1928) described two new species viz. D. ursulae and D. saxorum from the state. In the course of study of the genus for resived flora of India under the auspices of botanical survey of India, Deb and Dasgupta (1974) described one more species viz. D. maharashtrensis and one variety D. ursulae var. longeracemosae from the state. Thus with reference to present literature, genus Dipcadi is represented by 6 species and one variety in Maharashtra. The species considered to be endemic to India viz. D. concanense, D. saxorum and D. ursulae are found in Maharashtra and are restricted to very small areas.

Revesion on the genus Dipcadi are mostly based on herbarium specimens and noefforts have been made to study variation in populations of different species which has lead the workers to create new species. Some of these species do not stand as separate species. Moreover the characters on which the species are recognised vary with rainfall, soil condition and other climatic fadctors. Present study on morphology of different species have revealed that under improved conditior (grown in earthern pots and plots) the

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populations of same species show great increase in measurable characters such as leaf length and breadth, scape length, bract length, number of flowers per scape etc. In natural habitat, the plants growing in protected areas in good soil show marked increase in measurable characters over plants growing in open exposed poor soils. The characters such as filiform pedicel as against stout pedicel, bract length, leaf length and breadth can not be used satisfactorily in distinguishing species. Dipcadi maharashtrensis is distinguished from D. ursulae on the basis of nature and length of bract. Studies on populations growing at Panhala, Kas and Panchagni Plateau have revealed that every population posseses few plants with coriaceous bracts and bract length varies from 2 to 5 cm. Plants with long coriaceous bracts (D. maharashtrensis) easily cross with D. montanum and produce viable seeds. Moreover the species is based on single specimen which is without fruits. Therefore, D. maharashtrensis is simply a variant of D. montanum.

Dipcadi ursulae is distinguished from D.montanum on the basis of pedicel nature and degree of fusion of stamen with perianth tube. In D. ursulae the pedicel is stout and filament adnate in most part to the perianth tube, while in D. montanum the pedicels are filiform and filaments adnate wholly to the perianth tube. As stated earlier it is practically difficult to distinguish above said character

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and there is great variation in measurable character among population. Therefore author is of opinion that D. ursulae does not stand as separate species. D. maharashtrensis and D. ursulae are simply variants of D. montanum.

D. saxorum and D. concanense are endemic to Maharashtra. Most of the species found in India are concentrated in Western ghats of Maharashtra. There is great diversification in population of D. montanum in Maharashtra. These facts indicate that Western ghat of Maharashtra is secondary centre of diversification for the genus. So far D. saxorum is known only from its type locality. D. concanense is restricted to small area of Konkan. Both the species are rare and need conservation. D. concanense has definite ornamental value and could be good addition as an ornamental bulbous plant.

The Karyotype of D. concanense, D. saxorum and D. montanum represent specific differentiations. Karyotypes in all the species studied are bimodal type and indicate advanced nature of the taxa. Differences in absolute chromosome size reflects different amount of gene duplications either in tandom fusion or through polytene multiplication of chromonemata. The haploid chromatin length is minimum in D. saxorum followed by D. concanense ranging between 23.89 - 27.21 mu both being diploids with 2n=12, while in D. montanum (2n=20) with its various morphs,

it ranges from 38.04 to 48.21 mu and thus implies ploidy effect in the process of speciation. Wider range of TCL%, higher TF% and S% also are of indicative that specilization of Karyctype has taken place through hybridization, polyploidy and loss of chromosomes in the same fashion as proposed for Ornithogalum by Stedje and Nordal (1987).

The haploid compliment length of chromatin reported in D. saxorum by Naik (1974) is in aggrement with the observations made by the present investigation. Considering the basic karyotype, chromosome number and observations made in present investigation, it seems that D. concnnense is only affected by polyploidy and differing symmetry, and not by aneuploidy. The greatest diversity in morphological features and restricted distributional pattern of D. concanense suggest rather distinct line of evolution than other species of Dipcadi studied so far.

In D. montanum somatic chromosome number is 2n=20 with haploid chromatin length ranging from 38.04 - 48.21 mu and this may be suggestive of allopolyploidic nature of the species. The wide distribution of the species throughout India may be attributed to the presence of such cytological variation with morphological forms. At lower taxonomic levels the few and illdefined morphological traits and plastici have presented a satisfactory systematic differen-

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tiation until now in Dipcadi species perticularly in D. montanum because in nature its spectrum of variation was so large that these distinctions betweeen morphs lead to a different status of the taxa viz. D. ursulae, D. ursulae, var longiracemosae and D. maharashtrensis. Climatic, edaphic and precipitation factors obviously lead to variable growth patterns which makes delimitation of taxa based only on the exomorphic characters difficult. In this context detailed Karyotypic analysis of various morphs from various lccalities are found helpful toascertain the differences between them at chromosomal level. Karyotypes of various morphs of D. montanum (including D. ursulae, D.maharashtrensis, form with large bulb,broad leaves and long coriaceous bracts and narrow leaved form) show similar pattern and confer clear morphological varient status to said taxa.

There are significant differences in Karyotype of D. concanense, D. saxorum and D. montanum. Chromosome number 1,2 and 3 of all above species have similar relative chromosome size, while chromosome 4 and 5 are of distinct in nature in all the species. Chromosome 6 of D. concanense and D. saxorum is of same value, where as chromosomes 6 to 10 in different morphs of D. montanum are of similar value. Thus D. concanense, D. saxorum and D. montanum have a common genome of first 3 chromosomes, while remaining chromosomes are attributing species specific characters. Similarly the

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morphs of D. montanum viz. D. ursulae, D. ursulae with large bulb, broad leaves and long coriaceous bracts and D. maharashtrensis with coriaceous bracts of present investigation are simply morphological variants. It indicates the plasticity of the species acquired in varying ecogeographical conditions.

On the basis of the basic karyotype, chromosome number and data from present investigation it is clear that D. concanense, D. saxorum and morphs of D. montanum are affected by ploidy, hybridization and structural rearrangements in the genome.

Meiotic behaviour of meiocytes in all the species of Dipcadi viz.D. concanense, D. saxorum and D.montanum is associated with some irregularities. In D. concanense and D. saxorum the meiotic irregularities are less than D. montanum. This further implies that D. concanense and D. saxorum are diploids while D. montanum and its morphs are allopolypolyploidic in origin. In D. concanense and D. saxorum at Diplotene and diakinesis, presence of only one nucleolus associated with a variable number of bivalents was observed, while in D. montanum presence of two nuclei associated with variable number of bivalent was observed. Thus the phenomenon in general indicates that a process of conservation of adaptive gene complexes

is working in D. concanense and D. saxorum, while in D. montanum and its morphs, phenomenon of allopolyploidy and re-organisation of genome by structural alteration is in progress. For better understanding of evolution and diversification of Dipcadi species, studies on breeding behaviour, banding pattern of chromosomes and studies at molecular level is essential.

Anatomical studies on scape, pedicel, leaf and cuticle revealed that the general structure of these organs remains same in all the species of Dipcadi. Anatomical Characters are of little value in identification and tracing the evolution of the species. Various populations show minor variations in anatomical characters. Among the species studied, D. saxorum has got distinct type of vascular bundles. They are always broad and oval in shape as compared to D. concanense and morphs of D. montanum where they are narrow and elongated. The outline of leaf of D. concanense is peculiar. It is concave convex in shape while in other species the leaves are flat. Anatomical characters of pedicel remained same in all the species and it is difficult to distinguish between filiform and stout pedicel even on anatomical ground. The gross structure of cuticle is similar in all the species of Dipcadi. The leaves are isobilateral and amphistomatic.

Studies on floral anatomy revealed that the floral anatomy is simple and thecourse of vasculature remains

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similar in all the species investigated except variation in number of vascular traces to perianth lobes due to splitting of lateral bundles. Minimum vascular bundles per perianth lobe viz. outer perianth with 5 traces and inner with 3 traces was obsderved in D. saxorum while maximum vascular bundles per perianth lobe were observed in D. concanense and D. ursulae having large bulb, broad leaves and long coriaceous bracts. The floral anatomy was also found to be of little importance in distinguishing species under study.

Therefore these studies on morphology, cytology, vegetative and floral anatomy have revealed that there are three distinct species of Dipcadi in Maharashtra viz. D. concanense, D. saxorum and D. montanum. The species viz. D. ursulae, D. maharashtrensis, D. ursulae var. longiracemose can not be recognised as separate species. It is supported by morphological, anatomical,cytological studies and hybridization experiments. Therefore, above species are reduced to D. montanum. They are considered as ecogeographical and morphological variants of D. montanum.

Studies on embryology of D. concanense have revealed that the embryological chracters are similar to D.montanum. Anatropous ovule are bitegmic and crassinucellate. The style is hollow and stigma of wet type. There are 3 septal nectaries. The anther tetrasporiangiate. The

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development of anther is of monocot type. The tapetum is of secretary type. The microspore mother cell divide by successive type of division and produce isobilateral tetrads. The pollen grains are shade in two celled condition. Pollen grains are monocolpate and reticulate.

The ovary is tricarpellary syncarpous and superior. The ovule are bitegmic, crassinucellate and anatropous. The micropyle of ovule is formed by inner integument alone. Archesporial cell is hypodermal in origin. It divides periclinally giving rise to primary parietal cell and megaspore mother cell. The megaspore mother cell divides meiotically and forms linear tetrad of 4 megaspores. The chalazal megaspore gives rise to binucleate, 4 nucleate and finally 8 nucleate polygonum type of embryo-sac. Fertilization is of porogamous type. Endosperm is of the helobial type and embryogeny is of caryophyllad type.

Species of Dipcadi in Maharashtra are bulbous monsoon ephemerals. Nondormant seeds of all species germinate soon after their dispersal and survive the following dry season in the form of small bulbs. Further studies on Karyomorphology chromosome banding pattern breeding behaviour and studies at molecular level is essential to understand origin and evolution of Hyacinthaceae in general and genus Dipcadi in perticular. The experiment work on hybridization of various species of the genus in Maharashtra is in progress.

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