The chromosomes engrain the history of an organism and the process of its phylogenetic evolution. Consequently, chromosomal studies are considered to be key factors in solving problems of speciation and phylogenetic evolution. Bearing this in mind, the present investigations were undertaken to see if any light could be thrown on speciation and phylogenetic evolution of the family Compositae. Diversification has progressed profoundly in this family which makes it a very interesting group of plants for evolutionary studies.

The family is of considerable economic importance. A large number of genera are ornamentals. Many others are of medicinal or agronomic importance. The Himalayas possess tremendous potentials for horticulturals. In advanced countries the wild species have been exploited enormously, and through breeding of selected types, hybridization, induction of polyploidy and mutation, improved strains have been obtained. To undertake any such project an up-to-date knowledge of the distributional pattern, period of flowering, cytological data in respect of number, morphology and behaviour of chromosomes at meiosis and the frequency of polyploidy in nature are the essential prerequisites. Such considerations prompted the initiation of present investigations.

ABSTRACT

The chromosomes engrain the history of an organism and the process of its phylogenetic evolution. Consequently, chromosomal studies are considered to be key factors in solving problems of speciation and phylogenetic evolution. Bearing this in mind, the present investigations were undertaken to see if any light could be thrown on speciation and phylogenetic evolution of the family Compositae. Diversification has progressed profoundly in this family which makes it a very interesting group of plants for evolutionary studies.

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Distinguishing morphological features, distributional pattern, economic value if any, flowering period and cytological data based mostly on meiotic studies of 182 taxa belonging to 170 species comprising 86 genera together with discussions of pertinent cytological problems, are presented.

The chromosome counts for *Sphaeranthus africanus* (n=10), *S. indicus* (n=10), and *Brachyactis robusta* (n=9) are the first reports for these genera. New chromosome counts are made available for 32 species (marked * in Table II). Besides this 26 new cytological races are reported (marked + in Table II). Intraspecific differences in ploidy level are reported in 8 species: *Ageratum conyzoides* (n=10, 20), *Erigeron bonariensis* (n=9, 27), *Anaphalis margaritacea* (n=14, 21, 28), *Gnaphalium indicum* (n=7, 14), *Achillea millefolium* (n=9, 18, 27), *Chrysanthemum leucanthemum* (n=9, 18), *Saussurea candicans* (n=16, 17) and *Taraxacum officinale* (2n=24, 32, 40).

The following wild species of medicinal or agronomic importance in this country have been investigated.

- **M** *Adenostemma lavenia* (n=10)
- **M**, **E. O. L.** *Ageratum conyzoides* (n=10, 20)
- **M** *Solidago virg-aurea* (n=9)
- **M** *Grangea maderaspatana* (n=9)
- **M** *Sphaeranthus africanus* (n=10)
- **M**, **E. O. L.** *S. indicus* (n=10)
- **M** *Inula racemosa* (n=10)
- **M** *Xanthium strumarium* (n=18)
- **M** *Siegesbeckia orientalis* (n=15)
Some species, which are found in a wild state in India, are recommended for ornamental purposes. The outstanding among them are: Aster thomsoni (n=18, 2n=36), A. peduncularis (n=27), Erigeron mucronatus (n=18), Anaphalis margaritacea (n=14, 21, 28), Helichrysum buddleioides (n=14), Achillea millefolium (n=9, 18, 27), Anthemis cotula (n=9), Chrysanthemum leucanthemum (n=9, 18), and Gerbera lanuginosa (n=23). Species of Aster, Erigeron, Helichrysum and Chrysanthemum can be readily introduced into gardens. Others need improvement through cytogenetic methods.
Many weeds invade the cultivated lands and pose serious problems. The following constitute the more important species in India: *Vernonia cinerea* (n=9), *Ageratum conyzoides* (n=10, 20), *Acanthospermum hispidum* (n=11), *Xanthium strumarium* (n=18), *Sclerocarpus africanus* (n=11), *Blainvillea latifolia* (n=17), *Galinsoga parviflora* (n=8), *Carthamus oxyacantha* (n=12), *Sonchus oleraceus* (n=16) and *S. arvensis* (n=9).

As most of the cytologically known species of *Erigeron* possess n=9 or its multiples, 9 is concluded to be the original base number of the genus. Taxa with 2n=32 are probably tetraploids derived by subsequent elimination of some chromosomes.

With the finding of n=7 in the present investigation in *Leontopodium alpinum*, the probability of 7 as a second base number in the genus has been strengthened and *L. campestre* (2n=49, Sokolovskaja and Strelkova, 1938, cf. Darlington and Wylie, 1955) can now best be considered as a 7-ploid.

All species of *Anaphalis* investigated had the basic set of 14 excepting *A. margaritacea* in which cytotypes with n=14, 21 and 28 were found. The occurrence of a cytotype with n=21 and regular meiosis suggests the basic number for the genus to be 7 thus supporting the view earlier put forward by Arano (1963).

The genus *Gnaphalium* with x=7 represents quite a homogeneous assemblage.
In Inula 10 has been concluded to be a secondary number, probably a result of doubling of 5 (American species, Beaman et al., 1962) from which are derived taxa with 9 (American species, Beaman et al., 1962) and 8 (Japanese species, Arano, 1965) by aneuploidy.

Perusal of literature, supplemented with present investigations, does not reveal sufficient information to determine the base numbers for Medelia and Echinops. More extensive investigations are necessary to arrive at some definite conclusions.

On the basis of recorded observations, 13 has been concluded to be the base number in Spilanthes, while a new base number x=10 has been suggested in Coreopsis on the basis of present investigation and the recent report by Gupta (1969).

Various meiotic aberrations leading to total breakdown of meiosis have been described and their possible significance discussed in the following species:

Eupatorium glandulosum (2n=51), E. odoratum (2n=51), Blumea mollis (n=11), Helichrysum budeleoides (n=14), Inula cuspidata (n=10), Carpesium cernum (2n=40), Helianthus annuus (n=17), Janlia coccinea (n=32), Cosmos sulphureus (n=13), Artemisia vulgaris (2n=45), Hieracium crocatum (2n=27) and Taraxacum officinale (2n=24, 32, 40).

Apart from these aberrations of various types have also been recorded in :- Ageratum conyzoides (2n=20), Inula royleana (n=10), Tridax procumbens (n=13), Helium hoopesii...
Occurrence of a single interchange heterozygote is observed in three annual diploid species of Chrysanthemum: C. carinatum, C. coronarium and C. segetum.

A very interesting observation is recorded in Tragopogon gracilis. Cytological studies revealed that the largest of the 6 pairs of chromosomes has distinct blocks of heterochromatic segments. This pair has a deep primary constriction at submedian position. Because of late separation at A1 it apparently looks like a quadrivalent.

Interlocking of bivalents has been observed in Scorzonera divaricata (n=7). Occasionally as many as 6 chromosomes were involved in a complex configuration.

In summation, it has been concluded that the family Compositae is monobasic in origin with the ancestral basic number of x=5. The basic number 9, which is common in Anthemideae, Astereae, Cichorieae and a large number of genera belonging to various tribes, was derived from the diploidised state of the ancestral base of 5 by the loss of one pair. Thus the basic number 10 was among the first derivatives from the ancestral base. Further evolution progressed in various directions through polyploidy, aneuploidy, subsequent compounding of chromosome numbers and gene mutations.