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Chromosome Numbers in the Genus *Salvia* Linn.

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Chromosomes of 17 species with several varieties under 3 cultivated species of *Salvia* were studied. Necessary information on chromosomes was also collected from the previous literature to determine the basic numbers of the genus.

Chromosome number in the genus ranges between 2n = 12 (*S. hispanica*) and 64 (*S. cleistogama, S. funerea, S. horminoides* and *S. verbenacea*). Certain variations were found in chromosome number for the same species. This was probably due to the presence of several chromosomal biotypes, for which different authors have reported different chromosome numbers.

From this information it appears that the genus *Salvia* is highly polybasic having basic numbers of x = 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 19 and 22. The basic numbers of 6, 7 and 8 may be considered as primary and the higher numbers seem to be of secondary origin.

Key Words: *Salvia*, **Chromosomes, Basic numbers, Variations**

Introduction

Salvia is a widely distributed genus with more than 700 species (Willis 1966, Bailey 1969, Roy 1971). Several species are important for ornamentals, essential oils and medicinal purposes. In India the genus is represented by 24 species (Mukerjee 1940). The paper gives a synopsis on the comparative account of the chromosome numbers of the genus.

Results and Discussion

Chromosome number in *Salvia* ranges between 2n = 12 and 64. The lowest chromosome number of n = 6 (2n = 12) is reported only in *S. hispanica* (Sheel 1931, whereas the highest chromosome number of 2n = 64 has been reported in several species, e.g., *S. cleistogama* (Delestaing 1954), *S. funerea* (Epling et al. 1962),

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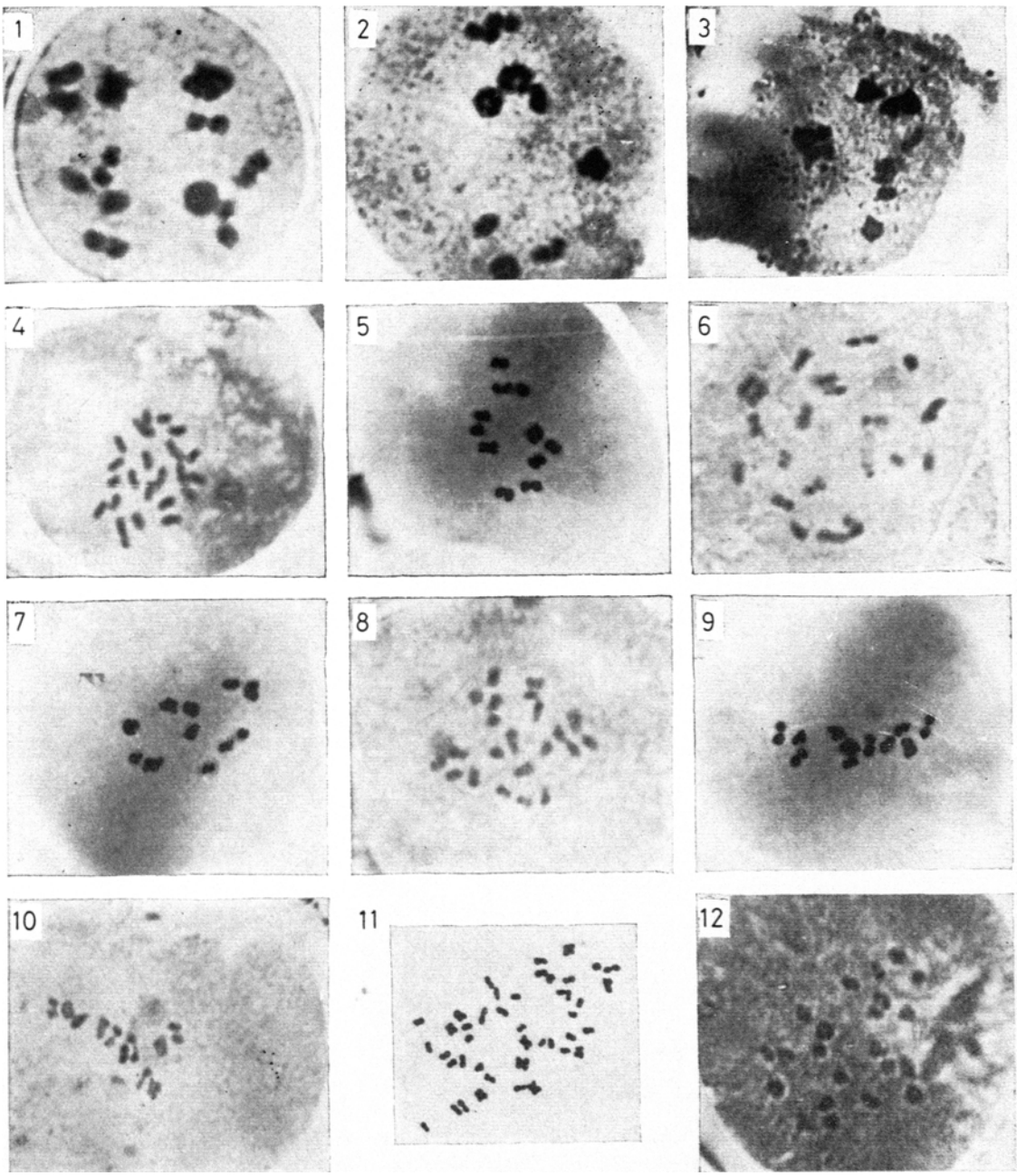
S. horminoides and *S. verbenacea* (Yakovleva 1933). However, different authors have reported varying chromosome numbers in *S. verbenacea*, e.g., 2n = 59 and 64 (Gadella et al. 1966), 2n = 42 (Reese 1957). Present study shows n = 27 (2n = 54) chromosomes, which is in conformity with the earlier observation of Benoist (1937).

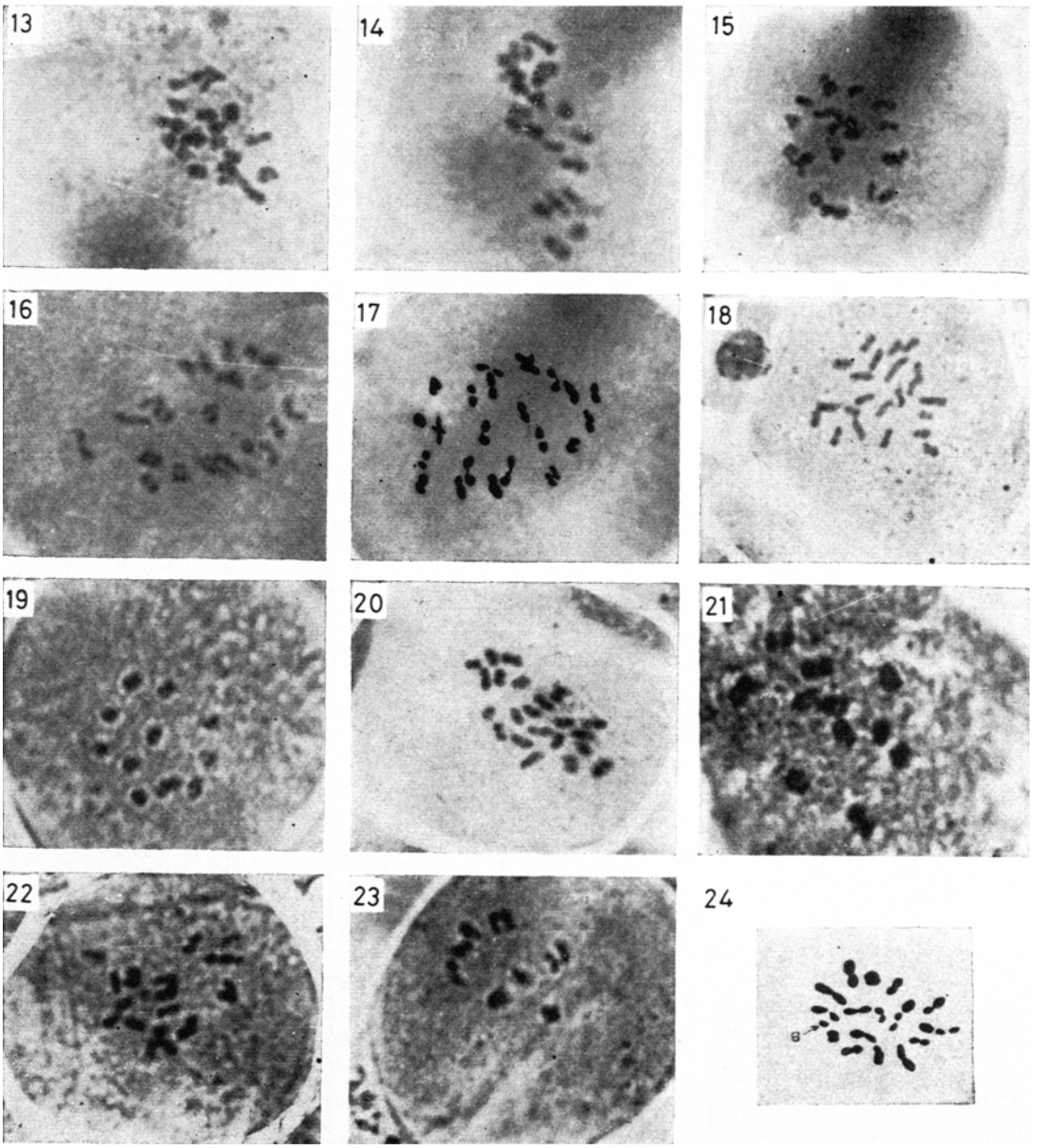
2n = 14 chromosomes are found in *S. nemorosa* and *S. officinalis*, which agrees with the earlier reports (Hruby 1935, Chauhan & Abel 1968, Gill 1971, Markova & Ivanova 1972). However, Majovsky et al. (1970) reported 2n = 12 for the former. Present studies on *S. glutinosa*, *S. pratensis* and *S. horminum* show n = 8 (2n = 16) chromosomes. In *S. glutinosa*, presence of n = 8 agrees with the earlier observations (Hruby 1935, Linnert 1955a, Majovsky et al. 1970, Skalinska et al. 1971) although certain chromosomal variations are found in meiosis. In *S. horminum*, Afzal (1972) reported 2n = 16+2 B chromosomes; however in the present study only 1 B chromosome was found. In *S. pratensis* there is a wide range of variation in chromosome numbers. Reports show n=9, 16 (Sheel 1931), 2n = 16 (Afzal 1971), 2n= 18 (Sheel 1931, Hruby 1934, Benoist 1937, Gadella et al. 1970, Majovsky et al. 1970, Chuksanova & Kaplanbekova 1971) and 2n = 20 (Sugiura 1936). However, the presence of n = 16 shows that there are some polyploid races.

In all the cultivated varieties of *S. farinacea*, e.g., Royal Blue, Lavender Blue and White, there are n = 9 and 2n = 18 chromosomes. But several authors have reported variations in chromosome numbers, e.g., 2n = 20 (Sugiura 1936) and n = 10 (Gill 1971). In the present investigation, the species was studied critically and it was found that majority of cells contain n = 9 (2n = 18) chromosomes, although occasionally there are n = 10 (2n = 20) chromosomes. Bhattacharya (1968) also mentioned n = 9 (2n = 18) chromosomes.

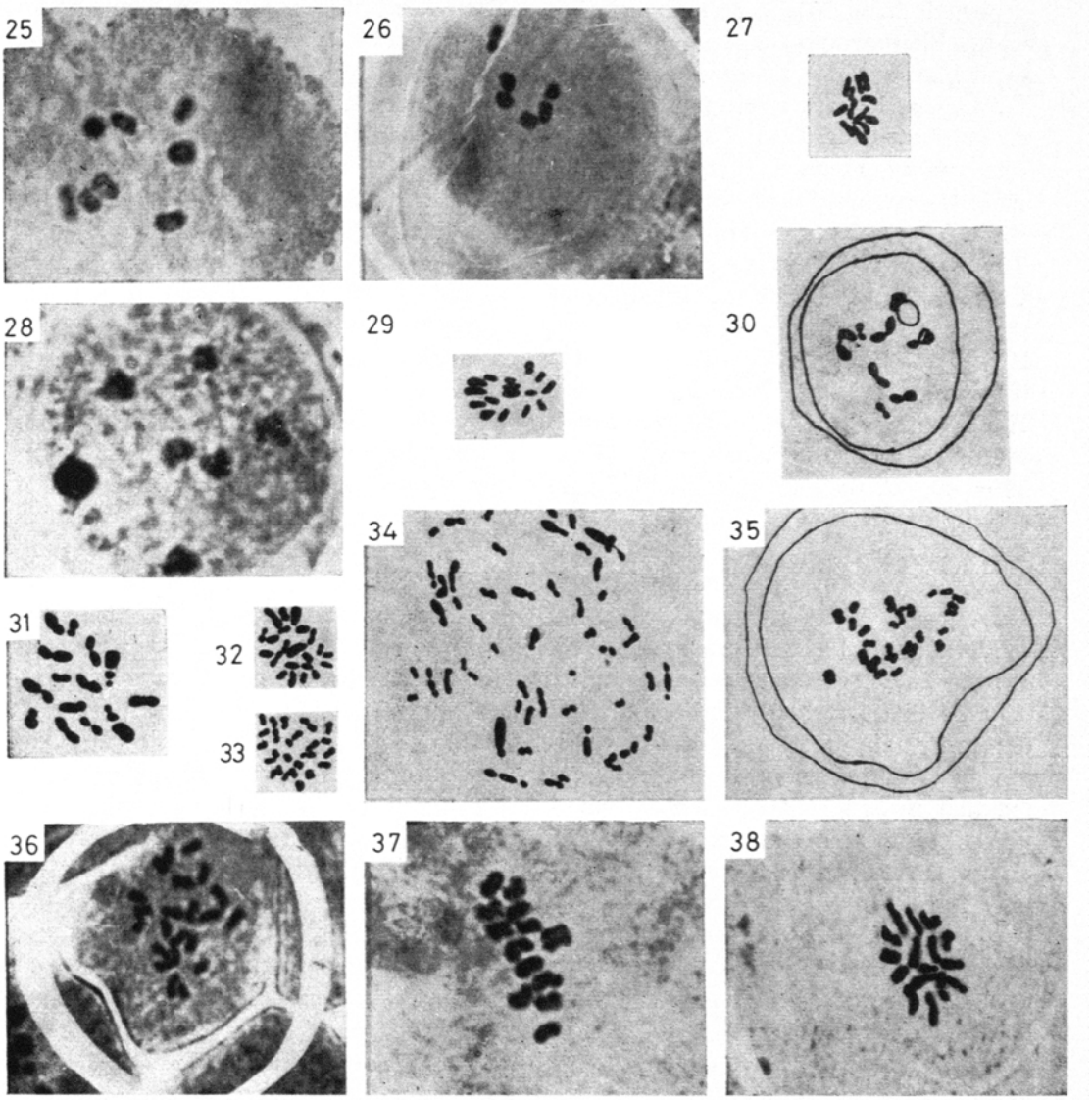
The only species studied with n = 10 (2n = 20) chromosomes is *S. reflexa*. The present observation agrees with the earlier one of Lewis et al. (1962). A number of species with n = 11 (2n = 22) chromosomes were studied, e.g., *S. coccinea*, *S. grahamii*, *S. tiliifolia*, *S. leucantha* and *S. aethiopis*. In *S. coccinea*, four varieties all cultivated, e.g., Red Indian, White Dove, Pink Pearl and Pseudococcinea show n=11 (2n = 22) chromosomes which is in conformity with the previous ones (Delestaing 1954, Erbrich 1965, Bhattacharya 1968, 1978 and Gill 1971) excepting 2n= 20 (Sugiura 1936, Harvey 1966) n = 12 (2n = 24) (Kumar 1942) and n = 22 (Gill 1971). The last-mentioned report is probably of a tetraploid. It is, therefore, probable that *S. coccinea* forms a heteroploid series with a haploid complement of 10, 11 and 12 chromosomes. Present investigation on *S. grahamii* shows n = 11 (2n = 22) chromosomes which agrees with the earlier observation of Raman and Kesavan (1963). *S. tiliifolia* with n = 11 (2n = 22) chromosomes is probably a new report. *S. leucantha* with n = 11 (2n = 22) chromosomes agrees with the earlier observations (Gill 1971, Vij & Kashyap 1976) excepting n = 16 by Carlson and Stuart (1936) and Bhattacharya (1978). Investigation on *S. aethiopis* shows 2n = 22, which is in conformity with the earlier one (Markova & Ivanova 1974); however, Felfoldy (1947) reported 2n = 24 chromosomes. *S. taraxacifolia* and *S. aegyptica* have been found to have n = 13 (2n = 26) chromosomes, however, Delestain g



Figures 1-12, Chromosomes *of Salvia Linn. S. farinacea* var. Royal Blue (n=9); *2, S. farinacea* var. White (n=9); *3, S. farinacea* var. Lavender Blue (n=9); *4-5, S. coccinea* var. Red Indian (2n=22, n=11); *6-7, S. coccinea* var. Pink Pearl (2n=22, n=11); *8-9, S. coccinea* var. White Dove (2n=22, n=11); *10, S. coccinea* var. Pseudococcinea (n=11); *11-12, S. splendens* var. Fireball (2n=44, n=22)



Figures 13–24, *13*, *S. splendens* var. Red Hussar (n=22); *14*, *S. splendens* var. Amethyst (n=22), *15*, *S. splendens* var. Grape Violet (n=22); *16*, *S. splendens* var. Rose (n=22); *17*, *S. splendens* var. Crimson King (n=22); *18–19*, *S. grahamii* (2n=22, n=11); *20–21*, *S. leucantha* (2n=22, n=11); *22–23*, *S. reflexa* (2n=20, n=10); *24*, *S. horminum* (2n=16+1B)



Figures 25–38, *S. glutinosa* (n=8, 6); *27–28*, *S. hispanica* (2n=12, n=6); *29–30*, *S. pratensis* (2n=16, n=8); *31*, *S. nemorosa* (2n=14); *32*, *S. aethiopis* (2n=22); *33*, *S. aegyptica* (2n=26); *34–35*, *S. verbenacea* (2n=54, n=27), *36*, *S. tiliifolia* (2n=22); *37*, *S. taraxacifolia* (n=13); *38*, *S. officinalis* (2n=14)

reported 2n = 28 for both the species, while Bhattacharya et al. (1971) mentioned 2n = 38 for *S. aegyptica*.

S. splendens was investigated with the six cultivated varieties. Of these in only one variety, Fireball, both somatic and meiotic studies were carried out. It showed n = 22 (2n = 44) chromosomes. The other varieties, e.g., Red Hussar, Crimson King, Amethyst, Grape Violet and Rose showed n = 22 chromosomes. However, previous reports showed a large variation, e.g., 2n = 20 (Furusato 1940), 2n = 32 (Carlson & Stuart 1936), 2n = 36 (Yakovleva 1933). 2n = 40, 42, 48 and n = 11, 14, 20, 24 (Bhattacharya 1968), n = 8 (Gill 1971). But many previous reports also mentioned 2n = 44 chromosomes (Sheel 1931, Hruby 1934, Raman & Kesavan 1963, Erbrich 1965, Bhattacharya 1968, 1978). These chromosomal variations may be due to the presence of distinct chromosomal races, which are now behaving as a new variety. It can be suggested that as *S. splendens* is highly cross-pollinating, hybridisation among the different varieties along with polyploidy may have played a great role in the origin of these new chromosomal races. In case of other species too, presence of such chromosomal races and biotypes are presumed. Figures show chromosomes of some of the species investigated.

Conclusions

Studies on the chromosomes of *Salvia* reveal the existence of x = 6, 7, 8, 9, 10, 11, 13 and 22 as the basic numbers. Gill (1971) studied chromosomes of 20 species of *Salvia* and revealed that the literature showed a frequency of the order of 21.7% of polyploidy in *Salvia*. Epling et al. (1962) established a new basic number of x = 15 in *Salvia* species from California. The most common basic numbers of *Salvia* are 6, 7 and 8. However, basic numbers of 9, 10 and 11 are also not uncommon. Stewart (1939) reported diverse haploid chromosome numbers as 8, 11, 12, 13 and 16 in the Californian salvias. It appears that the genus *Salvia* is highly polybasic having basic numbers of x = 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 19 and 22. The basic numbers of 6, 7 and 8 may be considered as primary and the higher numbers seem to be of secondary origin.

It is also seen that many *Salvia* species show extreme variations in both their somatic and meiotic chromosomes (Haque & Ghoshal 1975, 1980, 1981a). Various causes, such as genotypic, environmental and natural, have been put forth for explaining the same. Bhattacharya (1978) presumed that variations in pollen mother cells might have been originated out of the persistence of somatic variation up to the germinal line or through further variations in the premeiotic sector; their role in the origin of aneuploids is immense and the occurrence of natural aneuploids suggests that gametes remain viable and enter into successful fertilisation. Regarding evolution, Fujita (1970) suggested that *Salvia* is the most primitive genus in the family Labiatae with the highest primary basic number of 11. Among the different species studied *S. splendens* and *S. coccinea* are thought to be most advanced on the basis of studies on chromosome morphology and anthocyanin pigments (Haque et al. 1981b).

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