CHAPTER 1

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The family Solanaceae is one of the largest bisperm-pollinate families having 75 genera and more than 2500 species (D'Arcy, 1974). The genus Solanum which belongs to the tribe Solaneae of Solanaceae is one of the largest genera in plant kingdom being represented by approximately 2000 species (Obile, 1979).

The family Solanaceae shows a mixture of primitive and advance characters which create confusion to the taxonomists in deciding the phylogeny and correct taxonomic position of the family. The presence of trees, shrubs and perennial climbers shows its primitiveness. This is further confirmed by the occurrence of solitary, actinomorphic, bisexual, hypogynous flowers, bithecous anthers, endospermic seeds and numerous ovules per locule. On the other hand, the frequent occurrence of herbaceous annuals, gamopetalous condition, pentamerous flowers, epipetalous stamens, bicarpellary, syncarpous ovary and simple fruits indicates the advance features of the family Solanaceae. Some genera of this family further represent evolved features in their floral parts. Such as Petunia has four heteromorphic stamens with monoecious anthers and Schizanthus is characterised by sygomorphic condition and only two stamens.
Majority of the workers agree with its position in the group sympetalae. However, there is difference of opinion regarding its exact taxonomic relationship. Bentham and Hooker (1873-1876), Bessey (1893), Günderson (1950), Benson (1957) and Cronquist (1968) placed the family in the order Polemoniales. In Bentham and Hooker's system of classification Solanaceae is placed in between convolvulaceae and polemoniaceae but it is close to Molanaeaceae in Bessey system of classification (1893). In Bessey's treatment, Polemoniaceae and Convolvulaceae precede Solanaceae. Günderson (1950) placed Solanaceae between Molanaeaceae and Scrophulariaceae, while the polemoniales of Benson (1957) include Convolvulaceae, Hydrophyllaceae, Solanaceae, Polemoniaceae, Boraginaceae, Lennoaceae, and Molanaeaceae. However, Benson (1957) regarded that Solanaceae is very closely related to Scrophulariaceae. Takhtajan (1966) also is of opinion that Solanaceae is closely related to Scrophulariaceae. The Polemoniales of Cronquist (1968) includes Molanaeaceae, Solanaceae, Convolvulaceae, Cuscutaceae, Menjanthaceae, Polemoniaceae, Hydrophyllaceae and Lennoaceae.

The genus *Solanum* has a world wide distribution with a major centre of development in central and south America. The species of this genus are mainly classified into two groups, namely tuberiferous and non-tuberiferous. The tuberiferous species have attracted the attention of
Cytogenetists and Plant Breeders from time to time because of their great economic importance (Magoon et al., 1962). Comparatively little attention has been paid to the cytogenetics, hybridisation and reproduction of non-tuberiferous group. Non-tuberiferous species in general and *Solanum nigrum* complex in particular are also of much economic importance especially from medicinal point of view. This complex although difficult to define exactly, is considered to consist of *S. nigrum*, *S. mauritianum*, *S. nodiflorum*, *S. villosum*, *S. luteum*, *S. minutiflorum*, *S. gracum*; and naturally occurring diploid, tetraploid and hexaploid races of *S. nigrum*. These species show similarity among themselves and differ from other species of the genus to justify their inclusion in *S. nigrum* complex. The group of three cytotypes known as diploid, tetraploid and hexaploid *S. nigrum* has been the subject of investigation in the past to determine whether the three cytotypes constitute one species or two or three different species.

The taxonomist who has no training in cytology, genetics and biosystematics has been confused when dealing with these species. It has been shown that identification of these species can be done and the interrelationship of the species determined adequately only with the help of cytology, genetics and biosystematics. Some aspects of the
interrelationship of the species of this complex have been studied by Bhaduri (1945, 1951), Westergaard (1948), Randon and Rao (1964, 1966a, 1966b), Heiser, Burton and Schilling (1979), Edmonds (1971, 1972, 1979b) and Khan et al., (1977, 1978a, 1978b). The interrelationship of the species and races belonging to the same or different ploidy levels are still incompletely understood. The different aspects of the species such as comparative morphology, cytology, hybridization pollen size and induction of polyploids have been studied and all these data form the subject matter of the present investigation. This has been considered that all these information will help in the assessment of the taxonomic status and phylogenetic affinities of the species involved in our experiments. This cytological approach was considered necessary because these species exhibit a great diversity of forms and have proved to be a difficult taxonomic problem. In this group traditional methods of taxonomy has failed to elucidate their interrelationships. The boundaries between the species are generally ill defined and the situation has been complicated by the description of large number of species which are no more than slight morphological variants. Therefore, the biosystematic study of the members of this complex has been taken to explain their taxonomic affinities and to observe the effect of polyploidy, structural and numerical alterations of chromosomes in speciation within them.
The traditional systems of classification are mostly based on external morphology. Many plants, described as species, are found to be merely variants of other species and not full-fledged species. The species which is now almost universally accepted as the basic unit of taxonomy, has been subjected to more arguments over its proper definition than has any other biological term. Linnaeus (see Davis and Heywood, 1967) believed that species were divinely created, discrete and true breeding within its own limits. Some authors feel that there is no definition of species that may be considered universally applicable (Mayr, 1957, Davis and Heywood, 1967).

Since the rediscovery of Mendel’s work in 1900, biological science in general and systematic botany in particular have entered a new era dominated by the rise of cytology, genetics and statistics and their use as new tool for solving evolutionary and taxonomic problems. Cytological characters are now often regarded as of predominant importance in taxonomy (Smith-White, 1954; Darlington, 1946; Standing, 1952; Love, 1940).

Emerson (1945) defined a species as genetically distinct, reproductively isolated, natural population. He elaborates that the genetic difference may be morphological, physiological or behaviouristic. The isolation by whatever
mechanism, effectively prevents interbreed with other populations. Almost similar definition has been given by Stebbins (1950), who considered species as natural units separated from each other by gaps of genic discontinuity. The genic discontinuity involves morphological as well as physiological characteristics which are maintained by the absence of gene interchange between members of different species.

The biosystematists strive to determine objectively whether a particular taxon deserve the rank of a species or is of intraspecific level (Lawrence, 1951). In this approach, apart from morphological and histological consideration, emphasis is placed mainly on crossability between different taxa and on a homologies of chromosomes in the hybrids with a view to determine the reproductive isolation barriers and the degree of phylogenetic relationship.

Many biosystematists claim that species are natural populations which are genetically distinct and reproductively isolated from other species while being potentially interfertile among themselves (Mayr, 1942; Stebbins, 1950; Dobzhansky, 1931 and Huxley, 1963).

The most taxonomically perplexing type of plant group is the polyploid complex (Stebbins, 1938). In such
a complex species have mostly common morphological features besides the closely similar genomes. The species hybridise freely among themselves and produce fertile hybrids. Winge of Denmark and formulated a hypothesis of the origin of some species through chromosome doubling (see Stebbins, 1950) and the hypothesis was experimentally verified by Clausen and Goodspeed in 1925. The significance of polyploidy in the origin and evolution of plant species is well recognised (Stebbins, 1950, 1966; de Wet, 1971). Clausen, Keck and Hiesey (1945) stated that genetics, cytology, comparative morphology and ecology constitute biosystematics.

The type of variation within species which is most important in evolution is that showing certain regularities, particularly in connection with adaptation to ecological conditions. For this reason major emphasis has been placed on the concept of the 'ecotype' (Stebbins, 1950). This term was originally defined by Tureason (1922) as the product arising as a result of the genotypical response of an ecotype of species to a particular habitat.

Polyploids, as a rule are derived from their relatives with lower chromosome numbers. Once the suspected ancestral species has been identified, the hypothetical evolutionary course of hybridization and chromosome doubling can be repeated and hypothesis can be subjected to the experimental verification.
A hexaploid \textit{A. nigrum} has been synthesised from all suspected putative parents.

In the present investigation an attempt has been made to establish the interrelationship within the members of \textit{A. nigrum} complex and polyploids were produced from different triploid hybrids to find out the origin of higher chromosomal forms in this complex.